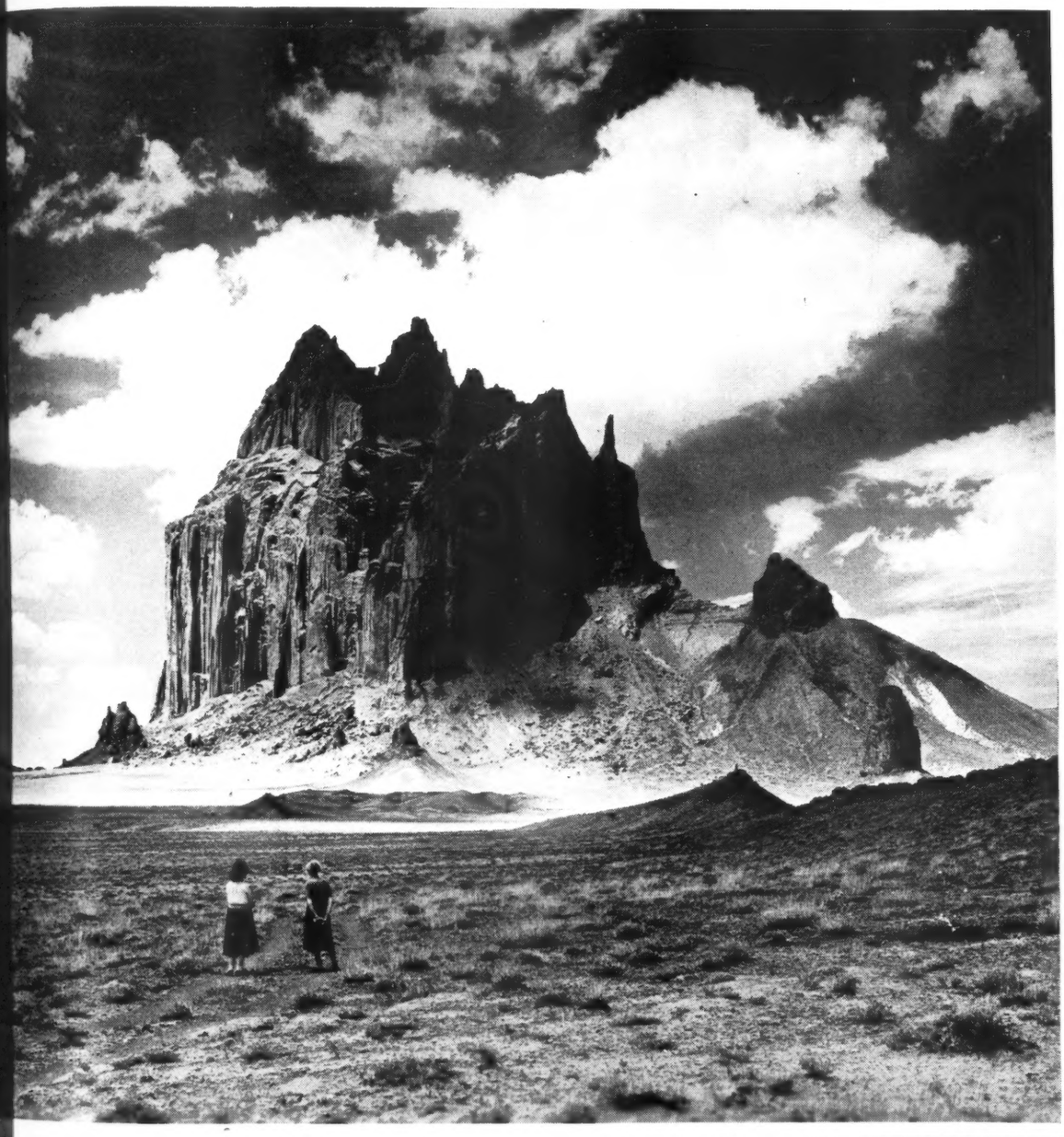
Compressed Air Magazine

AUGUST 1946



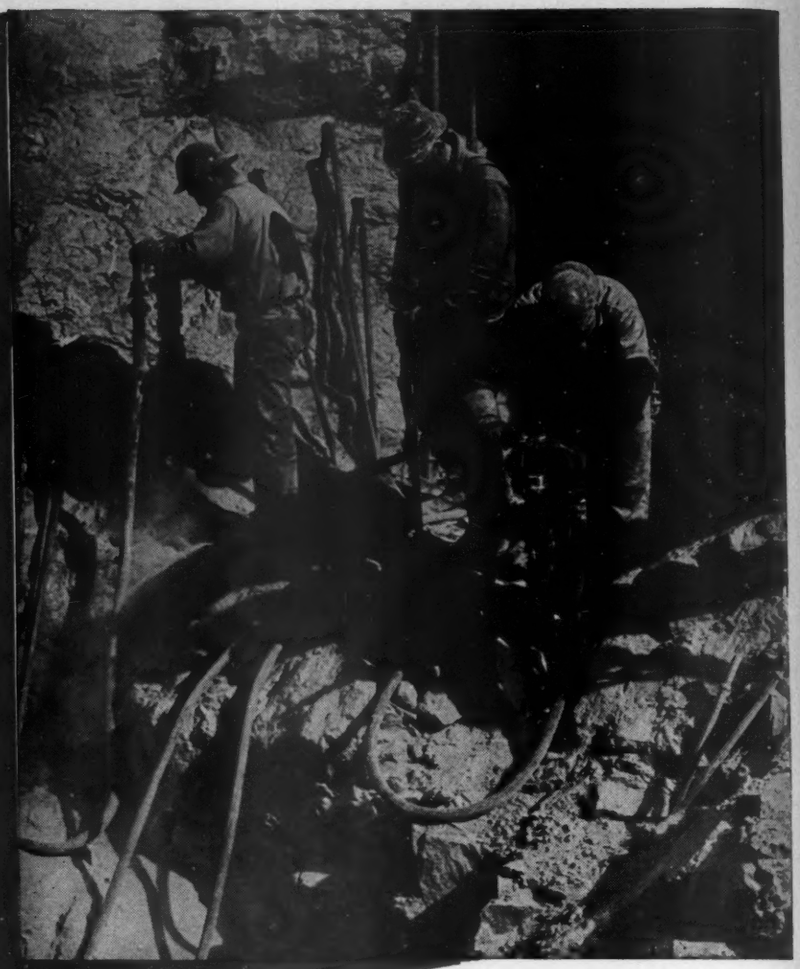
A LANDMARK IN NAVAJO COUNTRY

Shiprock, in Northwestern New Mexico, is familiar to travelers of Highway 66

(New Mexico State Tourist Bureau Photo)

VOLUME 51 • NUMBER 8 NEW YORK • LONDON

PLENTY OF E. P.



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TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON EVERY SUNDAY NIGHT—CBS

ON THE COVER

WHEN viewed from some angles, the rock formation pictured on our cover bears close resemblance to a ship—hence its name of Shiprock. It is an igneous intrusion that rises 1640 feet from a sandy plain, making it visible for many miles. Its cliffs are sheer, and it was not climbed until 1939. The landmark is in the heart of the Navajo country, and it has sacred significance to the Indians. Nearby is the Navajo helium project that is operated by the Government and that furnished some of the gas used in our dirigibles during the war.

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IN THIS ISSUE

WHEN George Westinghouse proved, in the face of many obstacles, that compressed air was the most suitable medium for braking railroad trains, he unconsciously determined the trend in brakes for heavy automotive equipment, even though the automobile was still several decades in the future. Appropriately, most of the brakes of this type produced in the United States are turned out under the Westinghouse aegis. Also appropriately, the factory that makes them uses compressed air on a wholesale scale to aid its operations. Our leading article gives the details.

•

NEW MEXICO, with two and one-half times the area of New York State, averages only about five inhabitants per square mile. It has abundant mineral resources, but lack of a home market has impeded the development of industries based upon them. Wartime demands for some of these raw materials boomed their production temporarily, and New Mexicans tasted prosperity. In an effort to keep it, they are exploring the possibilities of processing some of their minerals and shipping the products to neighboring states whose combined population runs into many millions. Our second article gives a general picture of the nonmetallics that await exploitation.

•

WAR is inevitably wasteful, and when the fighting ends as suddenly as it did in World War II a vast amount of used and unused material loses most of its value overnight. Much of it must be junked, but some of it can be profitably reclaimed if salvage operations are properly organized. Our third article tells how the Navy sifts thousands of returned articles to retrieve a modicum of the taxpayer's money.

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EDITORIAL CONTENTS

ADVERTISING INDEX

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AUTOMOTIVE AIR BRAKES

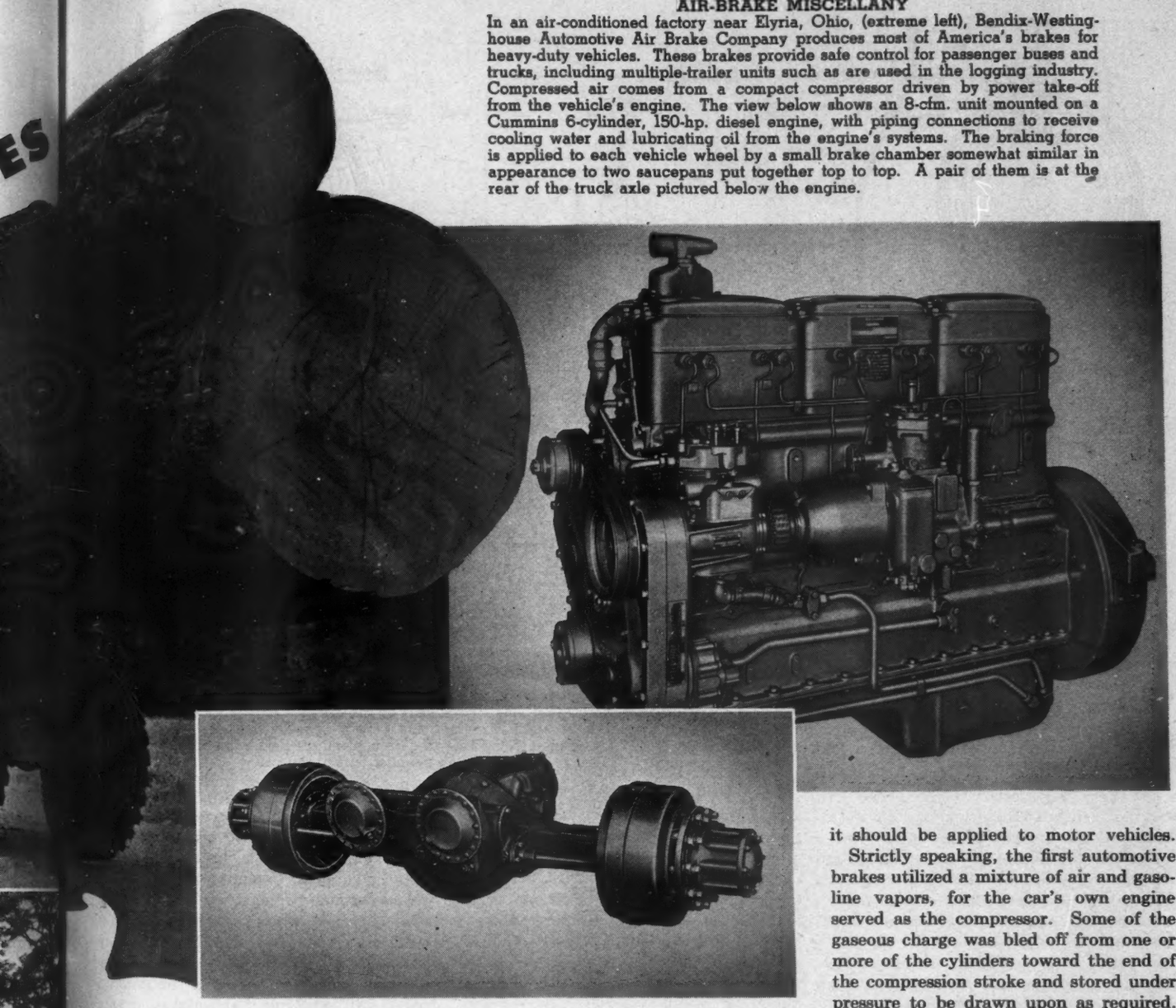
C. H. Vivian

MOST motorists have acquired a wholesome respect for the rapidity with which air power acts to bring fast-moving heavy highway vehicles to a quick stop. An experienced driver never creeps up too closely on a bus or a truck that is traveling on the level or downhill, lest the leading car halt so suddenly that he will be unable to prevent his own machine from crashing into it. But, for the benefit of the brash or unwary, many of these commercial vehicles still display at the rear an admonitory message such as "Caution—Air Brakes."

Power brakes are an outgrowth of the increase in size and speed of automotive vehicles. Early cars of all types had mechanical brakes that were applied on only the rear wheels. When faster running called for greater braking power, 4-wheel brakes were adopted. Although trucks were then comparatively small, an operator practically had to lock the wheels to make a quick stop when going at a fair rate of speed. This called for pressure on the pedal that was beyond the strength of the average man, so power brakes were developed. Now the heaviest vehicle on the road can be brought to a quick and effective halt with little more exertion

AIR-BRAKE MISCELLANY

In an air-conditioned factory near Elyria, Ohio, (extreme left), Bendix-Westinghouse Automotive Air Brake Company produces most of America's brakes for heavy-duty vehicles. These brakes provide safe control for passenger buses and trucks, including multiple-trailer units such as are used in the logging industry. Compressed air comes from a compact compressor driven by power take-off from the vehicle's engine. The view below shows an 8-cfm. unit mounted on a Cummins 6-cylinder, 150-hp. diesel engine, with piping connections to receive cooling water and lubricating oil from the engine's systems. The braking force is applied to each vehicle wheel by a small brake chamber somewhat similar in appearance to two saucepans put together top to top. A pair of them is at the rear of the truck axle pictured below the engine.



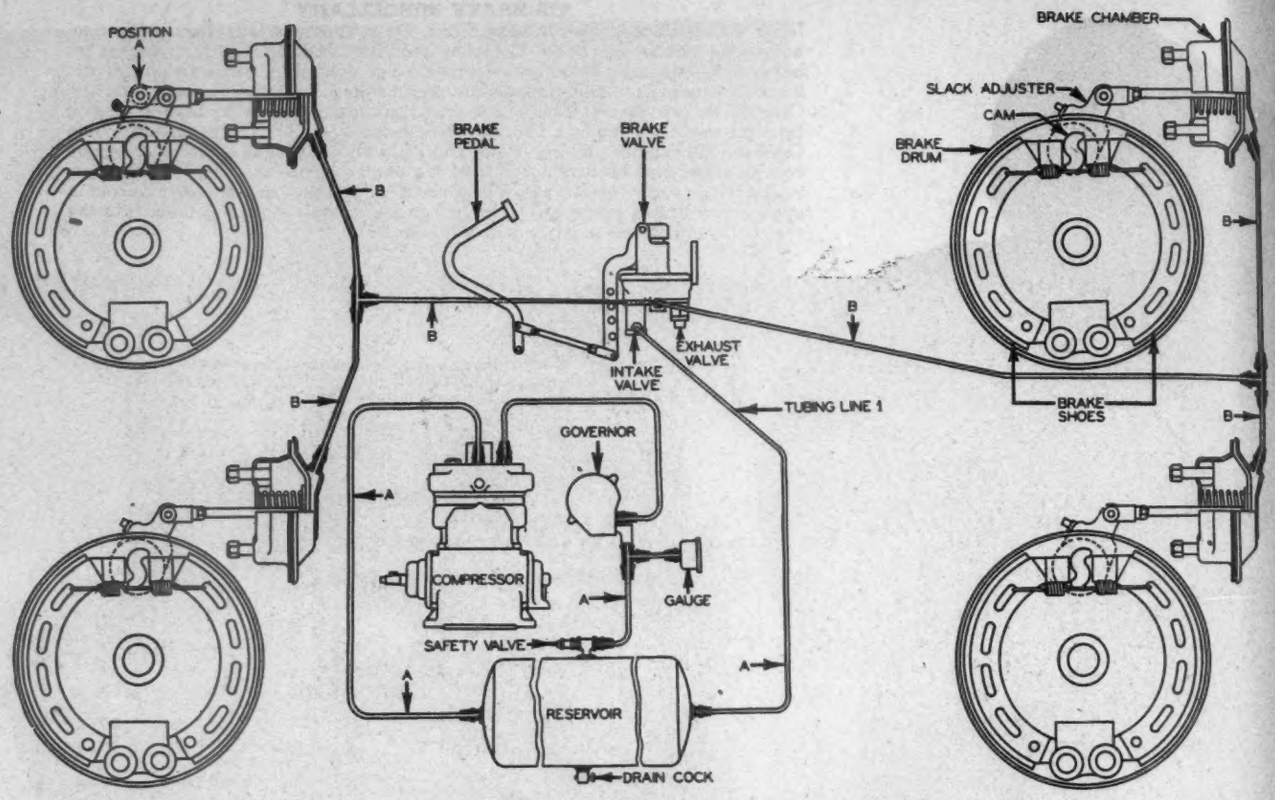
than it takes to depress the accelerator of a passenger car.

There are two types of heavy-duty power brakes, both of which are actuated by the force of air. The so-called vacuum brake works on the principle of Newcomen's atmospheric engine. Suction induced by the intake manifold of the propulsion engine creates a partial vacuum on one side of a piston enclosed in a cylinder. The pressure of the atmosphere on the opposite side moves the piston and thus exerts a pull on connectors linking it with the braking mechanism. Vacuum brakes are used on light trucks up to around 2½ tons capacity. Heavier trucks and buses require more braking power, and this is obtained by means of compressed air.

The automotive air brake is a direct lineal descendant of the railroad air brake that first brought fame to George Westinghouse. Although Westinghouse did not live long enough to have a personal hand in its development, it was brought into being by one of the companies he founded, and nine out of every ten brakes of this type now made in the United States are produced by a concern with which his name is still linked. It originated in 1920 at Emeryville, Calif., in the plant of the Westinghouse Pacific Coast Brake Company, a subsidiary of the Westinghouse Air Brake Company of Pittsburgh, Pa. At that time motor vehicles were growing in size, weight, and speed, and these factors, coupled with the increasing number of cars, created a need for a more positive method of controlling them. To meet it, the engineering staff at Emeryville, working under the guidance of the plant manager, S. G. Down, set about devising a power brake. Inasmuch as compressed air had been found to be the best operating medium for railroad brakes, it was only natural that it should be applied to motor vehicles.

Strictly speaking, the first automotive brakes utilized a mixture of air and gasoline vapors, for the car's own engine served as the compressor. Some of the gaseous charge was bled off from one or more of the cylinders toward the end of the compression stroke and stored under pressure to be drawn upon as required. After a period of testing, the new brake was offered to the trade on February 16, 1921. The first ones were used on big touring cars, but since then they have been applied almost exclusively to trucks, buses, and other heavy-duty equipment. The first application of the latter kind was made in the spring of 1921 on fire-fighting apparatus of the Borough of Wilkinsburg, a suburb of Pittsburgh. Others followed quickly, and were so successful that regular production of the brake was started in the shops of the parent Westinghouse Air Brake Company at Wilmerding in the Pittsburgh area. The demand grew steadily, and activities were soon segregated in a separate unit of the concern, called the Automotive Division, with its own shop and sales office.

Westinghouse Air Brake Company's principal business always had been with railroads, and it did not have adequate sales outlets to cover the automotive



BASIC BRAKING-SYSTEM DIAGRAM

This drawing illustrates the standard brake equipment and the fundamental operating principle that remains the same even when additional devices are used. The *A* air lines are under pressure at all times. When the brake pedal is depressed, the brake valve admits air to the *B* lines that feed the braking equipment. When the pedal is released, the intake port of the brake valve is closed, thereby again confining the pressure to the *A* lines. At the same time, the air in the *B* lines and the brake chambers is released through the exhaust port of the valve.

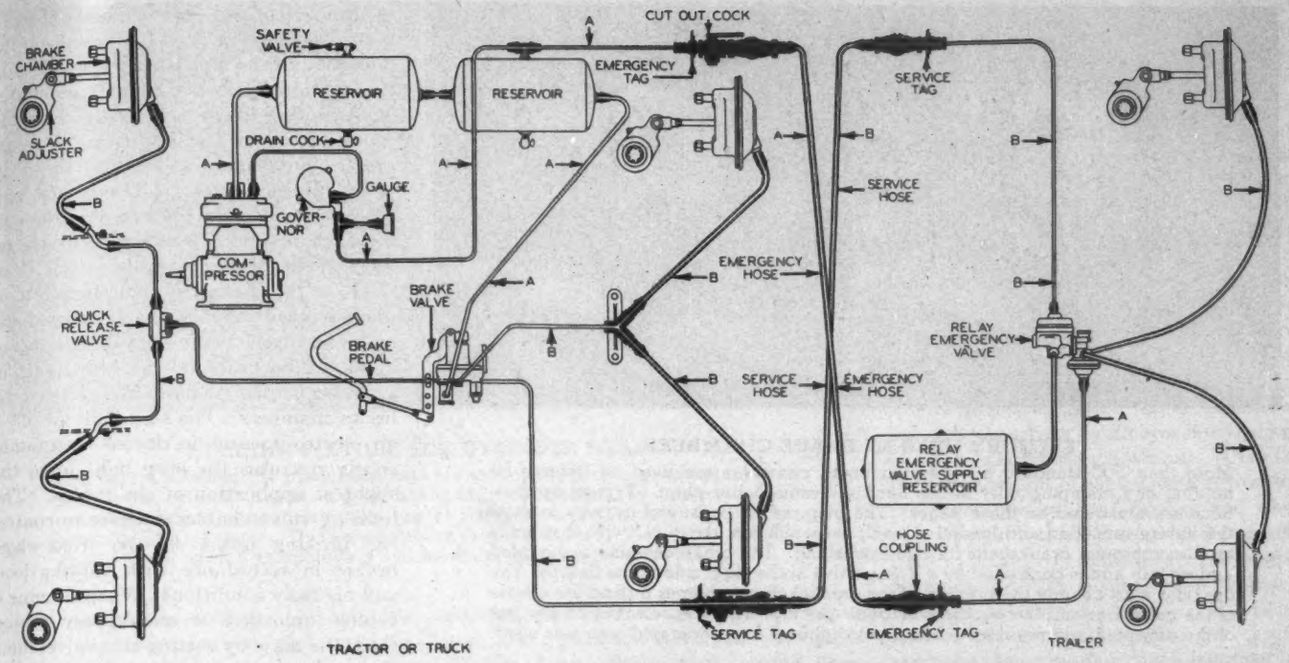
field efficiently. Accordingly, to improve merchandising of the brake, a new company was formed in 1930 in conjunction with the Bendix Aviation Corporation, which was already making several products for the automotive trade and had built up a sales organization for marketing them. The new firm was called the Bendix-Westinghouse Automotive Air Brake Company. Manufacturing operations were carried on at Wilmerding as a division of the Westinghouse concern until June, 1941, when a new plant was occupied at Elyria, Ohio, about 25 miles from Cleveland.

The basic principle of the original air-brake system is still retained, but there have naturally been many additions, refinements, and improvements to keep pace with the steady development and increasing carrying capacity of heavy-duty motor vehicles. One of the early major changes was the substitution of compressed air for the engine gases. This came about with the introduction of a small compressor that could be driven by the vehicle's engine. During the intervening years, compressed air has come into service on trucks and buses for purposes other than braking. The company has originated some of the devices concerned, and has broadened its line to include pneumatic gear shifts, clutches, steering mechanisms, throttles, etc. It also makes an air-operated horn. These developments, plus the need for progressively more braking power for the safe control of larger and larger vehicles, have demanded compressors of additional sizes, and they are now built in three sizes.

Most air brakes are installed on vehicles while the latter are being assembled in the factories where they are made. They are planned in detail by the respective manufacturers' engineers, and are naturally designed in each instance to meet the requirements of the particular type and size of car on which it is placed. Other brakes are put on vehicles after they are in service and are known as field installations. Distributors of braking equipment in various parts of the country maintain forces of factory-trained mechanics to do this work. In recent years air brakes have been applied to various classes of contractors' vehicles other than trucks, such as earth-moving units used on heavy construction jobs. These are called "off-the-road" vehicles. Virtually all the brake equipment made during the war went on military vehicles. Most Army trucks and many gun carriages were equipped with them. Many tanks included compressors and air-distribution elements because they were frequently used for towing vehicles that had air brakes but no source of power for driving a compressor.

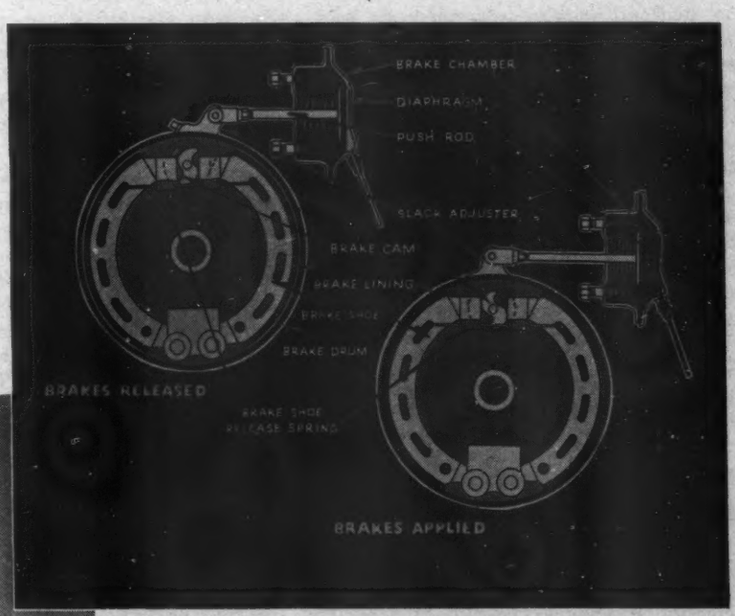
In its simplest form, the air-brake system consists of a compressor, air-distribution lines, governor, pressure gauge, safety valve, reservoir, brake valve, and brake chambers. Compressed air is conveyed through copper tubing to a storage reservoir from which it is withdrawn as needed to apply the brakes, which are operated by a treadle valve that looks and functions much the same as the conventional foot accelerator or pedal such as is used in actuating mechanical brakes. When a driver depresses the pedal, air is admitted to the lines supplying the braking devices. This is accomplished through the action of the brake valve which has an intake and an exhaust section. The intake is normally closed, preventing the "pressurized" air from going beyond that point. The exhaust valve is normally open, thus making sure that there is no pressure in the lines extending to the braking elements. When the pedal is depressed the intake is opened, the exhaust is closed, and compressed air immediately flows to the braking devices. When the pedal is released, this sequence is reversed—the compressed air in the afterpart of the system is exhausted to atmosphere and the pressure is again confined to the forepart.

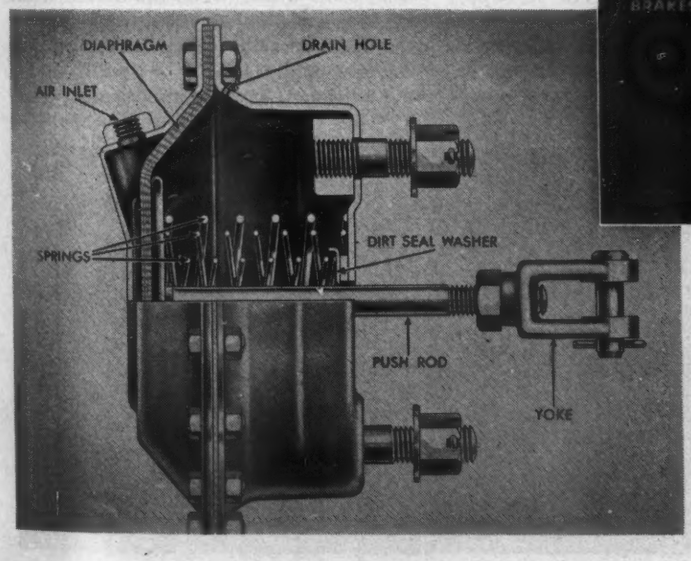
Actual application of the brake is made by the brake chamber, the construction of which is shown in an accompanying illustration. Pressure of compressed air upon a diaphragm serves to move the lat-



BRAKING CONTROL FOR TRAILER

The diagram above illustrates one of the various arrangements of the equipment available for tractor-trailer units. Two brake valves are used, one being controlled by the foot pedal and the other one by hand. The foot-operated valve applies the brakes on both tractor and trailer, while the hand-operated valve applies only the trailer brakes. This system enables a driver to brake the trailer independently of the tractor. It increases his control of the trailer when descending hills and under wet or icy road conditions and minimizes the possibility of jackknifing. The diagram also shows a relay emergency valve which serves two purposes. Under normal conditions the valve speeds up the action of the trailer brakes by drawing the air directly from a separate reservoir. Under emergency conditions, such as a trailer breakaway, the valve will automatically apply the trailer brakes.



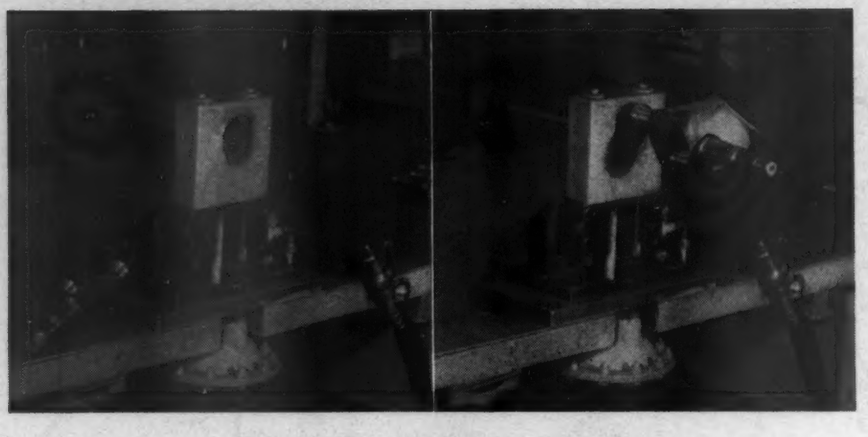


BRAKE CHAMBER AND METHOD OF OPERATION

The partial cutaway (left) shows the construction of the brake chamber, while the other view indicates how it applies the braking force. Air pressure entering behind the diaphragm moves the latter forward and with it a push rod. The rod rotates the slack adjuster, brake camshaft, and brake cam, thereby pushing the brake lining against the brake drum. When the air is exhausted from the brake chamber, springs return all the elements to their original positions and the brake is released. The brake chambers are made in seven sizes with effective diaphragm areas varying from 6 to 36 square inches. Using air at 60 pounds pressure, the force they develop ranges from 360 to 2160 pounds. The diaphragm is made of oilproof rubber and fabric.

ter forward and with it a push rod, the outer end of which is connected to the wheel brake by means of an arm known as a slack adjuster. Movement of the slack adjuster rotates a cam and thus forces the brake shoes against the brake drums. When the air pressure is exhausted, springs acting on the brake-shoe cam and one in the brake chamber return all the moving elements to their original positions, releasing the brake.

The time required to stop a vehicle from a given speed depends upon how the brakes are applied. If the pedal is depressed slightly, the brake valve delivers only low-pressure air to the brake chambers and, as the air has an opportunity to expand somewhat, the maximum reservoir pressure is not exerted in them. On the other hand, if the pedal is suddenly pushed clear down, full reservoir pressure rushes to the brake chambers and the brakes are set with full force. The best possible stop will be made when a brake is first applied



FACTORY USES OF BRAKE CHAMBERS

More than 500 standard air-operated brake chambers are used on fixtures for holding and clamping duty in the Bendix-Westinghouse plant. Typical applications are illustrated on these pages. The pictures are arranged in pairs to show the fixture unloaded and loaded in each case. Shown above is a vise that holds small compressor crankshafts for hand polishing. The brake chamber is mounted underneath and is controlled by a 2-way valve at the right side of the fixture. The operator must change the position of the crankshaft many times during the course of the polishing, and this can now be done quickly. This fixture saves 25 percent of the time formerly required when a conventional hand-operated vise was used.

as hard as speed, road conditions, and passenger comfort permit and is then graduated off as speed is reduced so that little pressure is being exerted as the stop is made. If the brakes are applied lightly and then more heavily as speed diminishes, a jolting stop will result and stopping time will be increased. In many instances an experienced driver takes advantage of the retarding effect of the engine to slow down his vehicle before applying the brakes, and it is claimed that a good operator uses air brakes less than he does mechanical brakes.

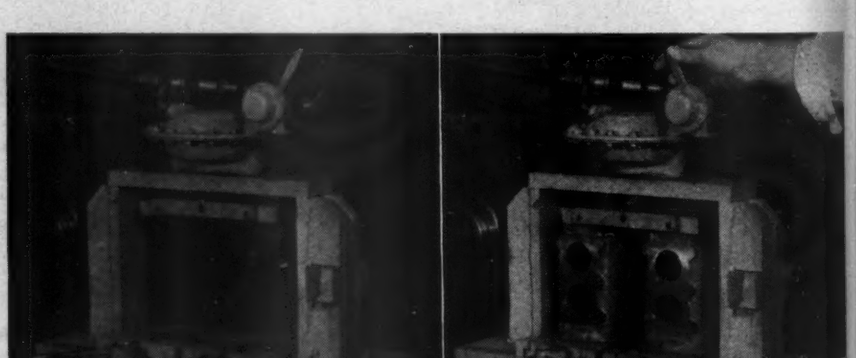
The governor automatically maintains the reservoir air pressure within a predetermined range, which is usually 80 to 105 pounds. (Effective braking requires as little as 20 pounds pressure.) When the pressure reaches the upper limit, unloader valves on the compressor are opened. Conversely, when the pressure drops to the lower limit, the unloader valves are closed. The safety valve is mounted on the reservoir and is designed to function in case the pressure should go up to 150 pounds. The gauge is on the dash in the driver's cab and affords a means of checking the reservoir pressure at all times. Should it fall below 50 pounds while the vehicle is traveling, a device known as the low-pressure indicator warns the driver by signal light, buzzer, or both, that he should stop and investigate.

The equipment just enumerated constitutes the standard brake system and the minimum requirement for the safe operation of an ordinary truck of small or medium size. Various additional devices are either desirable or necessary for larger trucks or buses and for tractor-trailer units. Even when they are employed, however, the fundamental operating principle remains the same as that outlined. In most cases there are two interconnected air storage reservoirs. This arrangement not only adds reserve power but also permits the first receiver to trap moisture, which condenses and can be periodically drained off by opening a pet cock at the bottom. Supplementary devices often used on trucks and buses are: a low-pressure indicator, an air-supply valve, a relay valve, a quick-release valve, a stop-light switch, and a limiting valve.

The low-pressure indicator automatically causes a warning mechanism to function when the reservoir pressure is less than the effective minimum for continuous brake operation. The air-supply valve, interposed in the line between the compressor and the governor, permits air to be withdrawn for emergency tire inflation and other purposes and causes the compressor to run all the while the air is being used. The relay valve speeds up the operation of the rear brake chambers. As it is actuated by only a small amount of air admitted from the brake valve, it functions when the brake pedal is depressed but slightly. In turn, the relay valve admits a greater volume of air from a reservoir into the lines feeding the rear brake chambers. It also speeds up the release of the brakes by causing the air in them to be discharged directly to atmosphere instead of following the normal and more circuitous route through the brake valve. The quick-release valve acts in a similar manner to discharge air from the brake chambers. The stop-light switch—an electro-pneumatic device—instantaneously operates the stop light upon the slightest application of the brakes. The limiting valve enables a driver to control the braking power of the front-wheel brakes in accordance with varying load and highway conditions. When running a vehicle unloaded or on slippery or icy roads, he may, by setting this valve, limit the air pressure admitted to the front brake chambers so that the braking force will not cause the wheels to slide.

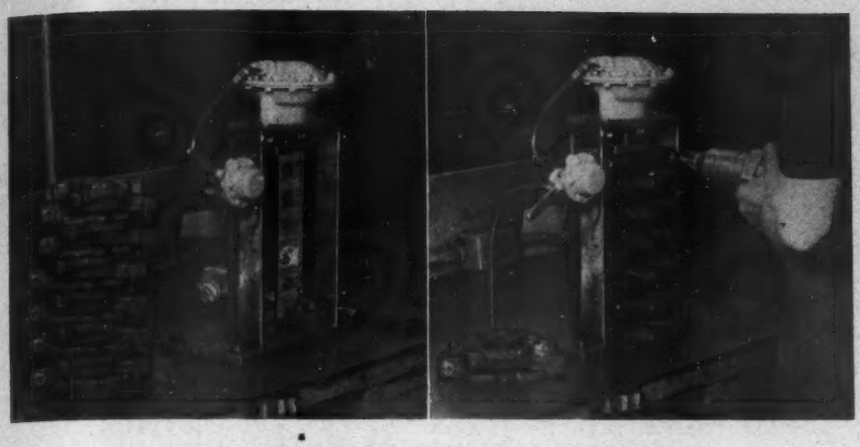
When auxiliaries such as a horn, windshield wiper, clutch, etc., are actuated by air, an auxiliary reservoir may be added to serve them. This precludes the possibility of the pressure in the regular receiver being reduced by them below the requirement for safe braking. Incidentally, records indicate that vehicles equipped with air-operated horns and windshield wipers make better time than others during storms or in heavy traffic. Apparently the air horn can be heard farther ahead than other types, while the action of the wiper is sure and effective, thus affording the best possible vision under adverse weather conditions.

Additional devices are usually intro-



CRANKCASE MILLING FIXTURE

A quarter-turn of the valve handle operates the brake chamber and the latter holds the pieces in position for milling by a Cincinnati duplex hydro-matic milling machine. With the bar-type fixture that was formerly used it was necessary to hand-tighten two nuts with a wrench. Then the allowed handling time per piece was 0.623 minute; now it is 0.176 minute. The air clamp grips the parts firmly and prevents chatter and slipping while they are being milled, whereas under the old conditions there was occasional cutter breakage because the bar was not drawn down tight enough to hold the parts in place.



HOLDING FIXTURE FOR CYLINDER HEADS

This fixture doubled the production rate of inserting ½-inch pipe plugs in small compressor cylinder heads. Seven heads are now clamped in position for the operation instead of handling them one at a time as was the case when a conventional vise was used. This eliminates six pickups of the air tool with which the work is done, as well as tightening and loosening the vise for each piece.

duced on tractor-trailers. When the tractor and trailer are used as a unit, the air-line connections between them are flexible hoses with couplings that may be easily disconnected by the operator but that will not become disengaged otherwise. The brakes on both are applied simultaneously by depressing the brake pedal. There are cutout cocks that are closed when the trailer is not in service so that the tractor brakes continue to function.

The compressors furnished with the Bendix-Westinghouse brake system are high-speed, single-acting, reciprocating units having either two or three cylinders. As the compressor is mounted underneath the vehicle hood, compactness is important and the machines have been designed accordingly. The trucking industry is becoming more and more concerned about reducing extraneous weight to a minimum and, consequently, there is a tendency to use aluminum wherever possible in compressors.

Being driven by the vehicle's engine, the compressor works all the time the engine is operating. Even though it is running without load a large part of the time, the duty is heavy for a small compressor and it must therefore be built carefully and of high-grade materials. Nevertheless, present production is at the rate of many thousands a month. Water-cooled units predominate, and are connected with the circulating system that serves the vehicle engine. Air-cooled machines are used principally where brake installations are made in the field.

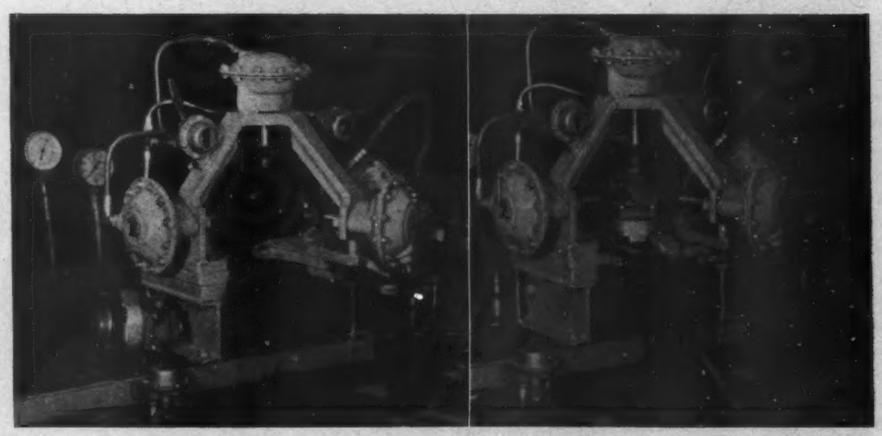
Most compressors also are lubricated from the engine's oiling system, but those made for certain automotive manufacturers and for field installation where there are no provisions for mounting them are provided with a built-in oil pump. Ratings of discharge capacity are based on an operating speed of 1250 rpm. Speeds higher than 1800 rpm. are not recommended. To exclude road dust and other grit, the intake air is passed through a strainer filled with pulled, curled hair. The company has a flat-rate repair exchange service that enables a customer to return a compressor, as well as other units of the system, to the factory periodically for overhaul or rebuilding. It is replaced by a factory-reconditioned unit that bears the same guaranty as new equipment.

The plant at Elyria consists of four buildings. The main structure—housing offices, machine shops, and assembly, tool, and shipping sections—is heat, light, and air conditioned. The company buys rough castings and forgings made to its specifications and performs whatever subsequent operations they may require. There are approximately 1400 employees.

Bendix-Westinghouse is definitely an air-minded concern. It not only produces pneumatic appliances but also uses compressed air extensively in making them. In fact, it is doubtful if there is another manufacturing establishment of its size that can count as many individual applications of air power as can this one. Inasmuch as the motive of the company, like others, is profit, it must be evident that there are sound financial reasons for this widespread utilization of compressed air. The truth is that it has enabled the firm to make substantial monetary savings and also to derive other benefits that will be mentioned later.

The turn to air power has been cumulative—it has grown by its own momentum, like a snowball rolling downhill. When the first applications of compressed air worked out favorably, others followed, and when they also proved advantageous it was only natural that a systematic search should be made for other places where air power could be gainfully adopted. This has not been a hit-or-miss program. A careful study has been made in each instance before changing the existing method of operation. The investigations are carried on regularly by the Tool and Methods Department of the factory and call for close scrutiny of all the factors involved. The data assembled include time studies, reactions of employees to the proposed innovations, safety considerations, etc.

Naturally, many of the changes made on the department's recommendation do not concern air equipment. Also, in numerous other cases the adoption of air power is only one phase of the revamping of manufacturing means or methods. It so happens, however, that compressed air has been applied to advantage in so many instances that it is unquestionably



FIXTURE FOR TREADLE-TYPE BRAKE-VALVE TEST

This set-up was devised to facilitate testing a treadle-type air-valve assembly for leakage and correct operation. The top brake chamber, actuated by No. 1 Valve, holds the part securely during the test. Three chambers arranged around the sides and operated by No. 2 Valve advance plungers to close ports on the treadle-type valve. The steady pressure they exert provides an airtight seal and insures a thorough test. The 2-way valve on the bench (lower left) admits air to determine leakage. Another valve admits air to a cylinder that actuates the pedal of the valve under test to simulate actual service conditions. Formerly, fittings had to be screwed to the part manually and other fatiguing operations were involved. Savings amount to 2.6 cents per valve tested.

the outstanding feature of the entire program. It has aroused much prideful interest among the company's management personnel because the predominating pneumatic device used in the factory is the brake chamber that is produced there as an essential part of the automotive air brake. This piece of equipment serves the same purpose as an air cylinder, but has been found to be preferable to it for work within the range of its capacity. The maximum stroke of the largest standard brake chamber is 2½ inches, and this has been found to be sufficient for all but a minor fraction of the applications. Wherever greater piston movement is required, air cylinders are employed.

Although they naturally leaned towards their own product, the methods engineers had sound business reasons for their choice of brake chambers. In the first place, they are less expensive than air cylinders, even though the shop is charged the same price that they bring through regular trade channels. Brake chambers also have advantages from an operating standpoint. Their diaphragm construction prevents leakage of air, and the absence of packing around the piston eliminates the friction inevitable in air cylinders. Because of these two features, maintenance problems all but vanish. Brake chambers have an average service life of a million cycles of operation. Although some have been used on fixtures continuously since 1941, the first failure of one of them is yet to be recorded.

The application of brake chambers in the factory has grown steadily until more

PNEUMATIC-TOOL APPLICATIONS

Pneumatic tools not only speed up various assembly operations but also make them easier to perform. In many instances, special holders and fixtures have been developed to save time and physical effort. The views at the top-right and bottom-left show a worker using two different tools at the same station. In the first one he is setting 5/8-inch studs in the nonpressure plate of a brake chamber with a Size 504 impact wrench. In the lower one he is running hexagonal nuts on the studs with a reversible multi-vane drill. Note the moisture separator and lubricator in the air line at the upper-left. The drill is mounted on a holder that keeps it vertical whether it is raised or lowered. When not in service, the holder is elevated out of the way, as seen in the companion picture. The girl at the top-left is operating a similar multi-vane drill. She is screwing a cover with a 3⅜-inch-diameter thread on a relay valve. The one at the bottom-right is using a Size 502 impact wrench to drive two 5/16-inch threaded bolts in assembling a double check valve.

FABRICATING RESERVOIRS

The size of the air reservoir for the brake system varies with the size of the vehicle, the average being 7x36 inches. The shell is made of rolled steel with a welded seam, and pressed-steel heads are welded on it. The picture at the right shows a continuous seam welder for the shells. Each reservoir is coated inside and out with black-enamel paint and tested under 250 pounds pressure. Air for this purpose is furnished by the Ingersoll-Rand Type 20 compressor seen below. In front of it is a finished reservoir.

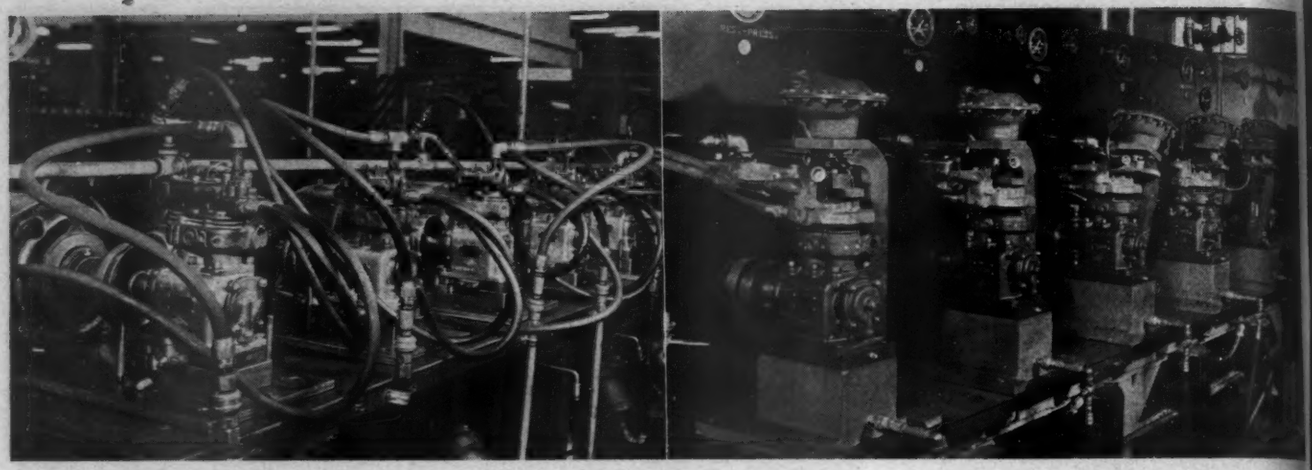
than 500 of them are now on some 400 separate fixtures. Although the saturation point is being approached, additional installations are being made. Most fixtures require only one, but a considerable number has two or more. The majority of the chambers are used in machining operations, but many are found in the assembly and testing sections. Typical examples of their services are described in connection with some of the accompanying illustrations. The chambers are actuated by control valves, which are usually of a simple rotary disk type. These valves, like the brake chambers, are standard parts made in the plant.

Early this year a time study of approximately 25 percent of the air-controlled fixtures disclosed that they were reducing costs at the rate of many thousands of dollars a year, and it has been increased since then through additional air-chamber applications. The cost of the air controls on the fixtures surveyed was only $2341, or a small fraction of the indicated annual saving.

The monetary saving has come about chiefly by lowering the labor costs that prevailed when manual or mechanical controls were in use. In some instances the labor charge per operation has been cut in half by reducing the time requirement. This has made it possible to transfer some employees to other work, but has displaced no one from a job. Employees have been generally receptive to the program, for in numerous cases the air controls have transformed arduous tasks into easy ones, and some operations that formerly called for men are now done by women. The program has also improved the plant safety record. Because an air clamp always exerts the same pressure, accidents have been eliminated that were formerly caused by a cutting tool striking a part that had been under- or overtightened by hand. There has thus far been no mishap that could be attributed to the improper functioning of an air chamber. The stable holding pressure also has done away with losses that were occasionally sustained through breakage of parts by overtightening them in fixtures.

The use of compressed air on fixtures has been supplemented by pneumatic tools, which have been adopted by the company wherever studies showed they would profitably speed up operations or render them easier to perform. Most of the tools are wrenches of various types and sizes that run on nuts, set studs, etc. Thread sizes of the pieces handled by them range from 5/8 inch up to 3 3/8 inches. Some of these tools are the new lightweight aircraft models that came into widespread service during the war. Others are the heavier units that have long been standard in many industries. In nearly all instances they are either mounted on special holders or suspended from overhead balancers. These aids make them readily accessible when needed and also lessen operator fatigue by supporting some of the weight of the heavier tools while they are in use. Obviously, on repetitive operations of the type that prevail in the plant, they save a great amount of time during the course of a shift. Selected examples of pneumatic-tool applications are shown in accompanying pictures.

Compressed air is used at various pressures and is supplied from four separate sources. For general plant purposes, air is compressed to 125 pounds pressure by a steam-driven 2-stage machine having a discharge capacity of 876 cfm. It is passed through an aftercooler that extracts moisture and reduces its temperature to approximately 108°F. This air is drawn upon to operate the brake chambers on the fixtures, as well as the pneumatic tools; it is fed to blowguns to remove metal turnings, etc., from machine tools, although this application is discouraged in certain cases because the air scatters the particles and may cause some of them to lodge in wearing parts of the machines; and it also actuates the controls of the air-conditioning apparatus. The shop distribution system consists of a 5-inch overhead line with 1¼-inch take-offs to the various machines. There are between 250 and 300 of these drop lines, and some of



COMPRESSOR TEST RACKS

Every compressor built in the plant is given a 1-hour running test under load before it is approved for shipment. Improved test racks have recently been designed and built by the company's own engineers, and in these pictures the new and the old fixtures are contrasted. With the old set-up (left), heads had to be bolted on each machine and the compressor itself secured to the base. An annoying jungle of hose connections had to be contended with. In the case of the new racks (right), a head is clamped on and the entire mechanism is held rigidly by a brake chamber at the top that swings over into proper position. Hose connections come in at the rear and are out of the way. The various readings required are taken from gauges on the panel. There are two of these new racks, each with places for twenty compressors, whereas the old fixtures accommodated fifteen. The ease and rapidity with which machines can now be set up enables one man to attend each new rack, whereas two were needed for each old one.

them serve as many as fifteen fixtures each.

Indicative of the relatively small volume of air that is required by the 500-odd brake chambers is the fact that the original compressor plant has thus far been able to take care of them even though they were not contemplated when the factory was constructed. However, in order to assure an adequate reserve air supply and to provide for future increases in air consumption, another machine with a capacity of 600-cfm. has been ordered.

For testing various products and for special purposes there is a demand for air at 175 pounds pressure. This is obtained by boosting some of the 125-pound air in a steam-driven compressor and is distributed in the plant by a 3-inch main having perhaps 50 take-offs. The air receivers or reservoirs of the brake assembly are tested under 250 pounds pressure with air furnished by a separate motor-driven unit. In conducting experimental work on air brakes for aircraft there is need for air at 2000 pounds pressure. This is supplied by a motor-driven, air-cooled, 3-stage compressor.

The success achieved by Bendix-Westinghouse with the brake chamber in its own operations has prompted the thought that other concerns engaged in turning out small machine parts and having manufacturing procedures and problems generally similar to those at Elyria may find it equally useful. It also seems likely that many other industries could apply the device profitably. Without having made any special effort to promote its general use, the company has already received orders from several firms. It may transpire that its experiences in improving its own plant practices will eventually lead to what might be termed an industrial business of considerable proportions.

Two examples of current applications of the chambers may be cited. A truck-trailer builder uses 24 of them to clamp structural frame members into an assembly for welding. All are controlled by one valve, whereas the C clamps formerly employed had to be tightened and loosened individually by hand. In another case, a manufacturer of a holding fixture embodies six chambers in his product.

BRAKE-CHAMBER ASSEMBLY

Here the various components of brake chambers are put together to form complete units. There are twelve stations on the circular table, which rotates at a predetermined rate to move the work along to the operators. Beyond the girl at the left may be seen one-half of a brake chamber with studs projecting upward. The one in the background puts on the other half, which has been preassembled, and starts the nuts on the studs. The operator at the right runs on the nuts with a Size 504 impact wrench, and the one at the left removes the finished work. These chambers are among the largest made and each has eighteen studs. The smallest size has twelve. From five to seven girls are usually stationed around one of these turntables, but some were omitted here so that the work might be pictured more clearly. Fifteen girls at three tables now assemble as many chambers as 22 did before this fixture was devised.

Nonmetallic Minerals of New Mexico

Fremont Kutnewsky

New Mexico State Tourist Bureau Photos

FLUORSPAR

Fluorspar was in great demand during the war for use in the steel industry, as a catalyst in one step of the manufacture of aviation gasoline, and in aerosol—insecticide—dispensers for the armed forces in the Pacific. New Mexico produced 10 percent of the nation's supply in 1944 and increased its output for the eighth successive year. Samples of fluorspar from near Deming are shown at the top. Near fluorspar deposits in the vicinity of Grants is a cave in which a perpetual band of ice is exposed (above). No logical explanation has been advanced for its existence in a region where temperatures are above freezing throughout most of the year.

NEW MEXICO has sufficient raw materials available for industry to give every one of its half million residents—man, woman, and child—a good-paying job if they could all work and if it had the industries. However, with all this natural wealth, New Mexico, of all the seventeen western states, drags the very bottom of the barrel when it comes to per capita income. Its raw materials mostly go to feed the hungry mills and factories of more prosperous states. Before the war, New Mexico had the highest percentage of unemployed in the United States.

But now, with postwar recovery in the air, the state is beginning to realize its potentialities. A nonprofit organization has been formed to acquaint westward-moving industries with all its natural advantages, not the least of which is a rapidly increasing population and an expanding labor force. The New Mexico Development Foundation is busy collecting evidence of conditions that are attractive to more than 60 kinds of processing and manufacturing industries and is negotiating for a dozen prospective enterprises. Many of these prospects are based upon the state's rich and varied resources in nonmetallic minerals. While the second world war brought practically no new industries to the state, it did boom mining and opened the door to vast industrial possibilities, especially in the production and the processing of nonmetallics.

When the Spaniards nosed into this part of the world some 80 years before the English arrived at Plymouth Rock there was little thought of anything but silver and gold. After our occupation in 1846, American adventurers followed the same lead. Like their Spanish predecessors, they fought the bloodthirsty Apaches for a chance to get at rich pockets of precious metals, and dug out a lot of them. Trudging over the rocky hills and sweating in their mine shafts, these treasure seekers passed up far greater wealth than they ever recovered in gold and silver.

While they were cleaning up the cash crop, the Machine Age began to materialize with its ever-widening demand for the so-called baser metals such as copper, lead, and iron. Mining for these ores reached its peak during World War I. Fortunes were made, but still greater opportunities lay ahead as America turned to chemical and technological development when caught short during that conflict. Then came calls for more and more of the lesser-known, lesser-valued minerals—potash, fluorspar, pumice, lithium, silica, mica, talc, and calcite.

In 1943, at the height of the industrial production that enabled this country to win the second world war, New Mexico contributed nonmetallics worth $87,000,000, as compared to $37,000,000 worth of metallic ores. Silver and gold had lapsed into insignificance. Copper and zinc, important as they were, took second place, being superseded by petroleum and potash. At that time the phrase "If you can't find it anywhere else look in New Mexico" became a byword among government scouts who were prospecting for rare minerals.

The important difference between metallics and nonmetallics mined in New Mexico is that the former feed only distant mills of established industry while the latter invite new fields of industry to the state. Markets are within easy reach for many kinds of processed and fabricated products made of or calling for the use of nonmetallics, the general demand for which is on the increase. Among the minerals of this class that did a big war job were helium, carbon dioxide, fluorspar, pumice, talc, and potash, all of which are found in New Mexico. In this

CLAY

Clays of many types abound in New Mexico and some of them have been used for untold years by Indian potters (top-center). Often they dig their supply of clay near their homes (above). Adobe, which is largely flood-plain clay, has long been favored as a building material by the Indians and Spanish residents. At the top-left is an adobe church near Pojuague that might pass for one of the early Franciscan missions. It has walls several feet thick.

group should be mentioned petroleum (the state is seventh in volume of production) and natural gas. The latter have far more applications now than formerly when they served primarily as fuels and lubricants.

New Mexico's potash deposits in the Carlsbad area have once and for all freed the United States from the danger of dying soils. After teaching us how to use that mineral in fertilizers, the Germans, who apparently controlled the world supply during World War I, counted on potash starvation to cripple the American war effort—and they came close to doing it. A frantic postwar search ensued, resulting in the discovery of beds in southeastern New Mexico and western Texas that are so extensive that there was no fear of a potash shortage during the second world war—in fact, there was a surplus for export. New Mexico fluorspar deposits also came to the rescue during World War II when other sources began to dwindle. Several mills were set up, notably the one at Los Lunas operated by the Zuni Milling Company that has good prospects of competing with other producers of high-grade acid spar in meeting the country's normal requirements. War-discovered uses for fluorspar derivatives —DDT, for example—have expanded its market.

New Mexicans now foresee considerable local industry in the chemical field because of the availability of potash and fluorspar. The present output of three large potash mining companies at Carlsbad goes largely to manufacturers of commercial fertilizers, but as the salts are the basic material of many essential chemicals they are being eyed, among others, by prospective makers of insecticides. By the time this article is published, the state will have its first fertilizer plant founded on an extensive supply of lignitic shales at Gallup. Its product will be a soil conditioner that contains 24 mineral elements essential to productivity and that has been used successfully as a cure for plant diseases. It serves to supplement commercial fertilizers.

GEM STONES

Ricolite, a variety of verde antique that is found only in New Mexico, outcrops in the cliffs of the Gila Canyon (above). Ricolite is used for decorative purposes as well as in jewelry. A section of a petrified tree protruding from a sandstone bluff is shown at the left. As turquoise becomes scarcer, Indian silversmiths are employing this agatelike rock more and more as settings in their distinctive jewelry.

Another important New Mexico nonmetallic is pumice, which is obtained at Grants. There is a steady peacetime demand for this ace of abrasives, which also found new applications during the war, namely, as an ingredient in nonslip deck paint and for processing high-octane gasoline. There are large deposits of pumice, pumicite, scoria, pearlite, pitchstone, and vermiculite scattered throughout the state that are being developed as a part of New Mexico's postwar industrial awakening.

Pumice and scoria (volcanic sinter) are being used extensively as aggregates in lightweight building blocks. Both, because of their glassy composition and cellular structure, have good insulating qualities against heat, cold, and sound, and they are practically fireproof. Some 50 or 60 companies in the state are engaged in their production according to varying formulas and with many kinds of aggregates, depending upon the local supply. There is more or less adobe and sand in most of these blocks which, in view of the scarcity of other building materials, have proved a boon to the construction revival going on in New Mexico, as elsewhere

Vermiculite is entering into the manufacture of a 3-in-1 plaster (sound, heat, and fire resistant) and of boiler insulation. The plant is in Albuquerque and is experimenting with a plastic roofing material containing vermiculite as the aggregate. It is applied like frosting is put on a cake and 2 or 3 inches thick. If tests prove it to be satisfactory, it may be the answer to the great need in the Southwest for roofing that will stand up under the hot sun-cool night combination that is so destructive to the materials commonly employed for the purpose. Vermiculite and pitchstone, of which there are adequate newly discovered deposits, are being considered for use in roofing tile.

Fostered by the Development Foundation, studies are being made of the possibility of manufacturing wallboard from pitchstone, which differs from pumice principally in porosity. Both are of volcanic origin and composed largely of silica. Pumice was blown out of the earth and hardened in midair while still full of steam. It is porous to the finest grain. Pitchstone hardened while static. It contains sufficient moisture to cause it to pop like popcorn when heated and expands to many times its original bulk. Properly exfoliated, it has the appearance of semirigid rock wool. Pitchstone wallboard, it is pointed out, would be termite- and verminproof. Efforts are being made to find some local vegetal substance that will combine with it to give it fibrous strength. The lowly yucca is believed to possess the necessary properties—tensile strength, pulping quality, and saponin to assist in decortication.

The building-material shortage has stimulated interest in New Mexico's large and varied beds of clays, gypsum, limestone, and cement rock. When it was discovered that, even in normal times, the state has a market for more than 450,000 barrels of cement annually, exclusive of public works, three companies announced plans to go into cement production there. Two of them have obtained sites close to the essential raw materials and fuels, either coal or natural gas. With the state's big postwar highway program and the new lightweight building-block industry the demand for cement has considerably increased.

There are extensive deposits of the purest-quality gypsum in various parts of New Mexico. Most noteworthy, perhaps, is the one in the Tularosa Basin near

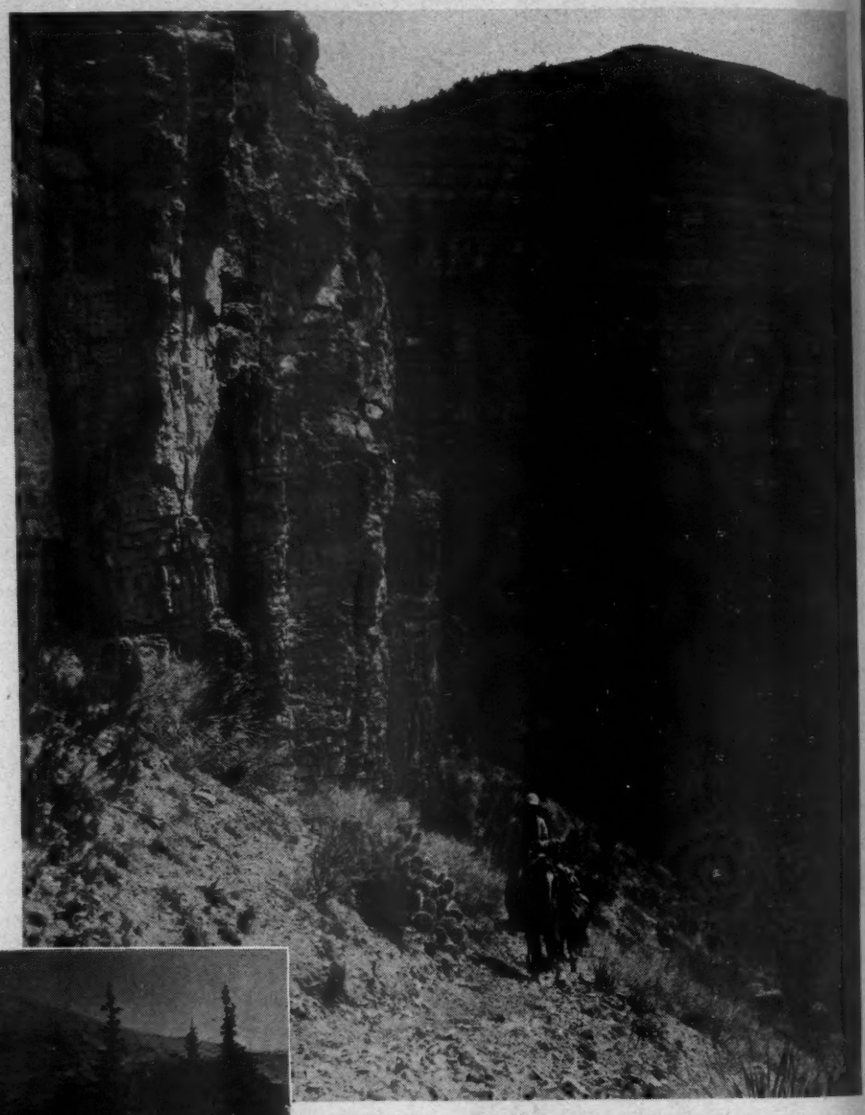
Alamogordo in the southern section of the state. There it exists in the form of a white sand that covers a wide valley floor in glittering dunes. Some of this area lies within the White Sands National Monument which is a scenic attraction for visitors. However, there is enough gypsum outside of its limits to supply all United States needs for a long, long time. It was close to this region that the world's first atomic bomb was set off, with the ensuing political and scientific reverberations.

New Mexico gypsum has been made into fine finishing tile, and is the basic material of a sizable novelty business in the vicinity. Curiously, a practice of the nearby Mescalero Apache Indians pointed to an application that may prove of far-reaching importance. It was observed that the Indians used the sand as a dry cleaner—to remove grease from their sheep pelts. A garageman tried it on his concrete floor and discovered that it not only absorbed oil and grease but, after frequent applications, also gave the floor a glaze that was resistant to oil and grease. As a sweeping compound it may prove to be a find, especially for garages and service stations. Meat-packing plants and factories where acids and oils are a fruitful source of bacteria have shown interest in the material. Gypsum for plaster and wallboard is always a good bet, and ample reserves await the enterpriser in the south around Alamogordo as well as in the northwestern part of the state.

New Mexico is rich in clays. No extensive studies of them have ever been undertaken, but they cover a wide range of qualities. The Indians of the Rio Grande Valley have been making pottery of clay for generations. Some excellent artwork, mostly for outdoor use on large estates, is being produced at La Luz near

SCENIC SETTINGS FOR NONMETALLICS

Close to the site in the Santa Fe National Forest between Santa Fe and Taos shown at the bottom-left are found mica and iceland spar, both of which were essentials of instruments used during the war. Dog Canyon, below was used as a retreat by the Apaches under Geronimo and Victorio when they were battling the U. S. Cavalry. Its sheer walls rise 2000 feet in places. It is accessible only by means of the Eyebrow Trail. Nearby, white glittering dunes of sand that cover a wide valley floor contain enough gypsum to supply the needs of the nation for a good many years. The potash mines that furnish 85 percent of our requirements are located not far from Carlsbad Caverns National Park (bottom-right).



COAL

Coal mining is a major industry in New Mexico. Investigations are now being made looking toward a coke industry that will utilize slack and produce ammonium compounds and other valuable substances as by-products.

Alamogordo; and the high school at Clayton, at the opposite end of the state, furnished its dining room with a sumptuous table service of local clay. Vocational courses in pottery making give promise of the commercial exploitation of the deposit in that section. Several artists in Albuquerque and Santa Fe have kilns for pottery baking, and find a ready market for their products. Some beds of the purest kaolin are known to exist in New Mexico, and quantities of it have been sold for use as fillers in oil cloth, paper, linoleum, etc., manufactured in other states.

A heavy blue clay from Roswell effectually stops leakage from artesian wells, which are the only sources of water for irrigation in the rich artesian basin of the Pecos Valley. Other clay in Lea County has been used for mudding oil wells in the Hobbs Field. In the vicinity of Fort Sumner, a semibentonite mixed with gypsum has been found to be excellent for lining irrigation ditches and is cheaper for that purpose than concrete. In this semiarid land it is vital that every drop of irrigating water be conserved. Adobe brick, the sun-hardened material of which the majority of New Mexico houses were constructed until the turn of the century, consists mostly of flood-plain clays. It is still a favorite building material of native New Mexicans and, because of its fine insulating qualities, is also used at times in structures of the costly type.

Bentonite, a claylike substance resulting from the devitrification and chemical alteration of glassy volcanic ash, is present in the state but has not been mined extensively. Chambers, Ariz., just across the border, is a well-known source of the material, which is much in demand for soaps and beauty clays. It has lathering and detergent properties and serves as a filler, binder, or plastic in paper. Further, it is used for refining fats and oils and enters into the manufacture of insecticides. It is a chemical agent in water softeners and an ingredient in various drugs and antiphlogistics. It is sometimes called "Denver mud." Bentonite is a perfect example of a common material for which more and more applications can be found, for there was a time when man had only two uses for it: as a soap and as a lubricant for the high-wheeled Conestoga wagons of days gone.

Since the war there is renewed interest in New Mexico in the making of fireclay. The raw material, one of excellent quality, has been mined in the Gallup area for a long time but has been sold to large smelters in the Southwest for lining furnaces. Now, an enterprise has been set up south of Gallup to manufacture fireclay products and other clay tile. The big Chino Mines copper smelter at Hurley, N. Mex., uses fireclay from a bed near Hatch, an area where there is ample water and a railroad, conditions that are favorable to the fireclay industry. Another mineral deposit at Hatch which is attracting attention is one of red oxide of iron, a valuable ingredient in paint. The state has huge reserves and a wide variety of colored earths all useful for coloring paints.

New Mexicans, especially industrial engineers, believe that it will be only a matter of time until we will see large glass works in the state. A deposit of silica, 97.7 percent pure and covering an extensive area, has recently been discovered near Tucumcari, seventeen miles from its eastern border, where an abundance of low-priced natural gas is available. The sands have not been given thorough investigation, but when the atomic-bomb explosion melted and converted them into a sort of crude glass for miles around the test site, interest was aroused in the possibility of New Mexico as a glass producer.

Efforts have latterly been made to extend a railroad line into the northwestern part of the state and on into the San Juan Basin, which lies partly in Colorado. The principal reason, beyond shipping fruit from that rich section, is to get at deposits of coking coals which are now in demand on the West Coast. New Mexico has very large reserves of different grades throughout the state. The soft coal in the area just mentioned has been found to possess a brown aniline base, which suggests the making of tannic acid. Experiments towards this end are in progress. This is significant in that more than 80 percent of the tannins now used in the United States are imported.

Coking coals near Raton in northeastern New Mexico are being studied in view of the fact that it is proposed to build a chemical plant there for the manufacture of ammonium nitrate and ammonium sulphate, benzol, toluol, xylol, nitrobenzene, aniline, naphthalene, phthalic acid, ammonium salts, nitric acid, and many medicinal products. Slack coal, for which there is hardly any local market, would be used for this purpose. The collieries at Raton and Gallup have suffered considerable loss of markets owing to the adoption of diesel engines by the Santa Fe Railway and the consumption of natural gas by the copper smelters of New Mexico and Arizona. An offer has already been made to buy large quantities of ammonium nitrate from the plant if it is erected, and this again fits into the picture of New Mexico as a source of fertilizers and other chemicals. In this connection it might be mentioned that the state has large resources of oxides of copper which could be converted into copper sulfate by leaching with 5 percent sulfuric acid and 95 percent water. The raw material could be obtained by open-pit mining.

During the war, successful attempts were made to furnish high-grade sheet mica. Colonial Mica Corporation set itself up in Santa Fe, but withdrew when the mica shortage was overcome. New Mexico looks forward to the full exploitation of its many deposits as soon as the market warrants it. In fact, it is thought to be feasible even at the present time provided proper sorting and storage facilities are installed. The demand for scrap mica

may lure producers in that field to New Mexico because of the extensive supply available there largely in outcropping veins.

The case of calcite—Iceland spar—is akin to that of mica. Early during the war the need for optical calcite became acute, and a deposit in Embudo Canyon met the emergency. A prominent optical manufacturer has made the statement that it saved the Allied cause with respect to range finders and other optical instruments essential to modern warfare. Spar from the property is said to excel anything found anywhere except Iceland, its chief source; but one piece that was taken out was then claimed to be the largest and finest ever recovered. The canyon is not far from the famed artist-colonized Indian Village of Taos, once the headquarters and now the resting place of Kit Carson.

Both lithium and talc, for which new uses were found during the war, are being developed in New Mexico. A body of talc 20 miles from Rincon produced considerable tonnages in 1943 and 1944 when the mineral was a "must" in the mixing of camouflage paint for battleships. It is also of value as a slip agent in the manufacture and handling of rubber. Lithium is one of the wonder materials of World War II, for it was discovered that a little of it in glass would eliminate the glare and reflection ruinous to long-range photography. Now that reflectionless glass is here we may look forward to show windows that will make displays appear as though they were out in the open, as well as to automobile windshields that will lessen the danger of accidents through blinding light. Lithium is mined near Taos, and other sources near Rociada and Las Vegas are in process of development. Meerschaum is another rare mineral that exists in the Silver City area of the state. That produced so far contains too much quartz grit to make it suitable for smoking pipes, but the material has been ground and used for lining less expensive pipes of this kind.

Carbon dioxide, "dry ice," was obtained in its natural state from New Mexico wells some years before the war. This was a "first," because it had always been manufactured before that. No battleship is complete without carbon-dioxide fire-fighting equipment. After the dry ice is pressed into blocks it is sawed into cubes 10 inches square weighing approximately 60 pounds each. These are wrapped in specially designed double sacks of heavy paper and loaded into standard refrigerator cars. As they are well insulated, the loss in volume in transit is less than 1 percent a day. Four plants prepared 75 tons for the market daily in 1942. The principal use of solid carbon dioxide is as a refrigerant for long-distance shipments, and it is said to be from ten to fifteen times as effective as water ice. It is also in demand for quick-freezing, a field that is expanding rapidly today. In liquid form it serves variously to carbonate water and beverages, as a food preservative, and as a fire extinguisher—in fact, it is claimed to be the best oil-fire extinguisher known.

Other nonmetallics in New Mexico which have economic possibilities are graphite, zirconium, alum, sulphur, and building and gem stones. Some fine granite is being quarried near Las Vegas, and a great deal of native sandstone and limestone has been used for local structural purposes. Gem stones include turquoise, agate, petrified wood, blackwood, obsidian, and ricolite. Turquoise has long been identified with the popular southwest Indian jewelry. However, as the supply of that gem decreases the use of petrified wood mounts. And now it seems that ricolite, of which New Mexico has the only known deposit in the world, will provide the lapidary with a suitable substitute. Ricolite, a variety of verde antique, is also made into objects of art. There has been a revival of gem grinding and polishing since the war, an inviting field for anyone looking for a small, independent business.

New Mexico is being rediscovered largely because of its reserves of nonmetallic minerals. Industrialists are becoming aware of the fact that it lies in the midst of a great shipping area. Seven hundred miles from the center of the state to the east as well as to the west are regions with populations of 16,000,000 and 6,000,000, respectively. Potential enterprisers with an eye towards New Mexico are aware that 22,000,000 people represent a fine market. The states involved are Texas, Arizona, Colorado, western Kansas, Oklahoma, Utah, Wyoming, Nevada, California, Idaho, and southern Montana. The establishment of fast-hauling truck lines and the building of new highways are removing the barriers of distance that have hampered industrial growth.

New Mexico is not looking for any wonders to come to pass, but is beginning to appreciate that its raw materials will continue to find new applications as time goes on. Other significant factors in its development are the westward trend of industry in America and the increasing tendency towards production at or near the sources of basic materials. The state should also appeal to industrialists who are thinking of happy employee-relations, for people are more likely to be content in a region that appeals to them. The fact that New Mexico in normal years has attracted ten times its population in tourists and that immigration is bringing in settlers all the while, all point toward marked economic expansion.

CARBON DIOXIDE

Some of the natural-gas wells in northeastern New Mexico produce carbon dioxide that is compressed in plants such as this one to make the solid form known commercially as "dry ice." It is sawed into 10-inch cubes weighing about 60 pounds each, wrapped in insulating paper, and shipped in refrigerator cars to points of use. In liquid form it serves as a fire extinguisher, as a food preservative, and to carbonate water and beverages.

How the War Navy Salvages Equipment

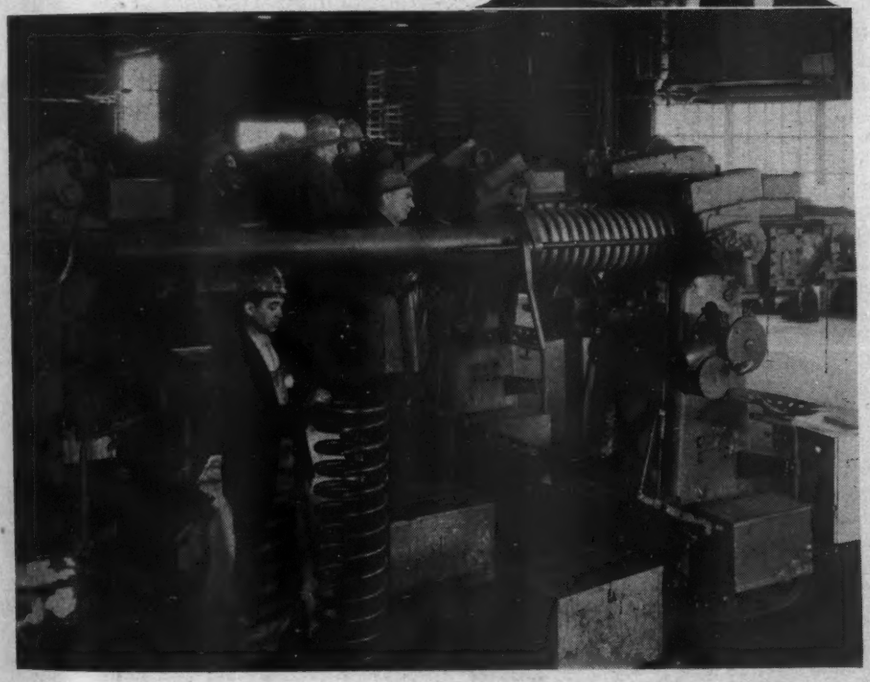
R. G. Skerrett

All photos from U. S. Navy

THE resourcefulness of naval technicians has converted a great wartime plant in Maspeth, Long Island, to peacetime employment and thus possibly saved it from becoming a "white elephant" on the hands of the Defense Plant Corporation. There, under the direction of the Navy, essential matériel either damaged by wear or by superficial impairment while in storage is being made fit for reuse and has already netted the national treasury many millions of dollars.

The potential white elephant, which was to produce a huge quantity of aluminum, was supplied for its electrical equipment with about 3300 tons of silver valued substantially at $66,000,000. That metal was used for making bus bars and was not exposed to fusing heat. All but 9 pounds of it was recovered after the plant was closed down in May, 1944, by which time the nation's stocks of aluminum were ample to meet all needs.

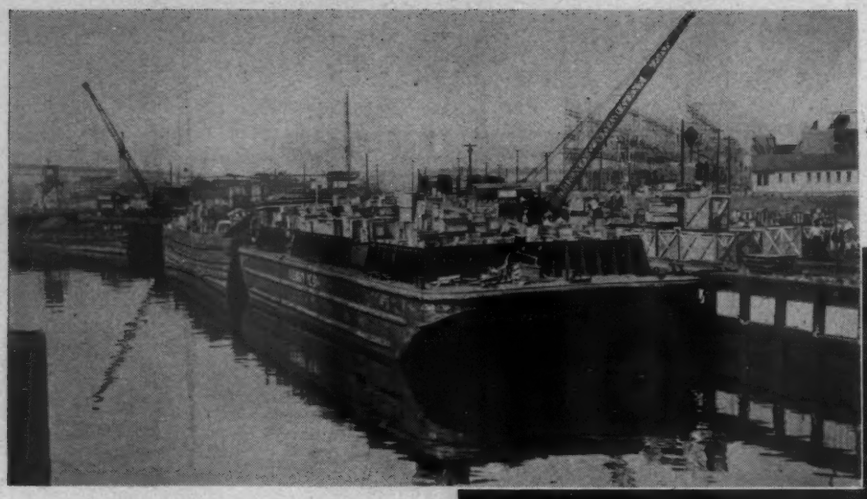
Before the Aluminum Company of America ended its activities at Maspeth, the New York Naval Shipyard in Brooklyn had become overcrowded and it was necessary to find additional space in which to carry on the mounting work of its Salvage Unit, which was handling all sorts of things classed as "battlefront backwash." With private manufacturers busy day and night and contending with manpower and material shortages or restrictions, it became evident to the Bureau of Ships of the Navy Department that pressing demands of fighting craft might be satisfied if some of the returned articles could be reconditioned for reissue instead of being broadly classified as scrap that would have to be disposed of or take up valuable space. The answer was the Salvage Unit, the money for which was authorized in July of 1943. The wisdom of that course has been substantiated by the splendid results achieved; but the public has been told little about the magnitude of the job.



BEFORE AND AFTER

Three-inch rapid-fire guns undergoing cleaning and overhaul are shown in the lower view. Note the size of the recoil spring that absorbs the "kick" of the weapon when fired and returns it to reloading position. Two of these guns that have been gone over thoroughly and put in shape for possible future service are shown at the top. They will be shipped to an inland storage point.

The wear and tear of a large fleet and the ceaseless demand for a high degree of performance do not permit of leisurely overhaul, and working parts and machinery are apt to be scrapped offhand when even moderately damaged—so much depends upon precision of action. Therefore, thousands of major and minor implements of war forming the outfittings of such craft were shipped to the naval base in Brooklyn from battlefronts and other stations connected with naval operations. The stuff arrived either packed or unpacked in widely differing stages of impairment and included guns, internal-combustion engines and their parts, radar equipment, torpedo tubes, fire-control instruments, refrigerators, pumps, potato peelers, tools of many kinds, metal helmets, electric apparatus, and what not. The aim has been to save from the scrap pile anything that could be made serv-



INCOMING MATERIAL

By railroad and barge, war equipment of every conceivable sort arrives at the salvage center from widespread theaters of war.

iceable again within permissible limits of cost and labor.

The New York Naval Shipyard has what is called the "outside machine shop" —actually within its confines—where some reconditioning is done by a labor pool made up of men awaiting assignment to a vessel that is undergoing overhaul, or has just arrived for that purpose, and others who are taking an apprentice course. This shop has reclaimed, month after month, articles to the value of $130,000 that could be delivered to the local supply officer for reissue—a striking verification of the maxim about the stitch in time that saves nine.

When the inflow of such matériel became too heavy for handling within the shipyard, then the Maspeth Annex, as it is called, was established at the erstwhile Alcoa plant and placed under the direction of Rear Admiral F. A. Daubin, USN. Its principal activities have to do with the salvage and repair of ordnance equipment and diesel-engine parts. The work started in February, 1944. Whenever possible, it has been farmed out to the original manufacturers or to qualified contractors; but by far the bulk of the reclamation has been done at Maspeth. There, in the first six months of 1945 was reclaimed ordnance and associate matériel valued at nearly $6,340,000. Weapons and parts worth $1,500,000 were distributed within the Third Naval District centering on New York City, while shipments valued at $4,000,000 went to points outside that district.

One of the difficult problems in connection with ordnance has been the matter of terminating contracts between the Government and the concerns that have helped the Navy to do its part in beating the Axis. These contracts were canceled shortly after V-J Day, and the matériel on hand had to be disposed of within set limits of time. Much of it is coming into Maspeth where it is processed and then disposed of through civilian agencies if the Navy does not need it.

The guns that have been made fit for reuse have ranged from small arms to 5-inch 38-caliber rifles. Reconditioning consists of disassembling, cleaning, replacing of worn parts, reassembling, checking, and painting—each job calling for workmanship capable of meeting the standards fixed for similar ordnance when new. In the small-arms class, 45-caliber pistols, for instance, are overhauled, refinished, and then undergo prescribed trigger-pull tests. Automatic weapons such as Thompson 45-caliber machine guns are handled by a working force of more than 50 women who are trained for the work in a small-arms school and whose deft fingers quickly take the weapons apart and put them together again.

An idea of what can be realized from such screening operations was indicated by a test made with a group of girls who were engaged in recovering small pieces of hardware. The question had been raised as to the monetary value of that salvage effort. A check-up was accordingly arranged, and it revealed that an outlay of only $119 for labor resulted in salvaged items worth $1100. Two controlling factors are taken into account before a job is authorized; namely, there must be a need for the particular instrument or part, and the cost of making it fit for reissue. If the need exists and the cost of reclamation does not exceed 50 percent of the current value of a new part or instrument then the work is approved.

Fire-control equipment has much to do with the amazing effectiveness with which naval guns are brought to bear and held upon dimly visible shifting targets while hurling salvo after salvo at them in rapid succession. Details of these apparatus are carefully guarded, but even to the casual observer it is evident that some parts are rugged while others are extremely delicate, as they must be when mechanisms are set in motion or halted by feeble electric impulses. Corresponding niceties are involved in radar equipment that also reaches Maspeth for salvage. Again, details are not available for publication, but it is of present interest that thousands of parts from these instruments are sorted, cleaned, and packed by operatives skilled in the work.

The Ordnance Salvage Center is well equipped and employs 625 men and women. At present, the most urgent job is that of dealing with the guns from the nation's armed merchant fleet. The officers and men of the "Armed Guard Units" on those vessels had to remain attached to them—could not be released from service—until the weapons were removed. As a result of pressure brought to bear on the authorities to hasten demobilization, the guns have been landed and started for Maspeth with dispatch. There they are put through the shops, the work

mainly involving cleaning. This necessitates disassembling each piece to get at all the parts for degreasing, the removal of corrosion, and then reassembling it for shipping to another plant for final overhauling preparatory to placing it in permanent storage where it is held under conditions that will keep it in readiness for reissue for active service. For example, 3-inch 50-caliber guns are consigned to the Naval Ordnance Plant at Louisville, Ky., at the rate of 100 to 125 a week, while from 15 to 25 of the more formidable 5-inch 30-caliber rapid-fire rifles leave each week for the Northern Ordnance Plant at Minneapolis, Minn. In the case of 20-mm. antiaircraft guns, about 110 are dealt with daily—the work entailing reclamation as well as scrapping. Any weapons or parts of gun mounts that are declared obsolete are so effectually damaged by means of metal-cutting torches that their reuse as such is impossible.

The Ordnance Salvage Center brings to attention an interesting side light on the rapid technological advances made during the war. Stimulated by the urgency of the conflict, the inventive mind found many fighting tools lacking—tools that but a short while before were believed to be perfect and likely to remain so for a long time to come. Improvements, sometimes radical, often made such weapons obsolescent or actually obsolete. One function at Maspeth is to lessen the cost of this obsolescence by saving those working parts and fittings that are still good for use in a newer gun.

Again, the task may be one of saving most of a piece and its attachments while preparing for betterments that may make it and its class more effective. This is being done with the rapid-fire 3-inch rifles which were previously equipped with manually controlled mounts but which are being converted to power drive so that they will be more responsive in combating a fast-moving target. No doubt, the most complex of the mounts dealt with there are those for the 5-inch 38-caliber guns. The latter are fired by remote control and are intricate in their get-up. To disassemble one of these pieces, clean it, and then put it together again calls for expert handling and a high order of workmanship at nearly every step.

Only parts that are obsolete or beyond economical reconditioning are assigned to scrap piles to feed the foundries in the New York Naval Shipyard, or are otherwise disposed of by auctioning when large quantities have accumulated. The value of the operations in this section of the Maspeth Annex from January 1 to November 1, 1945, can be summed up as follows: The total moneys spent within that period amounted to $807,809, and the materials reclaimed as a result of that expenditure represented an original purchase price of $12,758,000.

Much of the cleaning of rusty or dirty parts of returned ordnance is done by putting them through successive baths of hot water, chemicals, and special solutions that prepare them for a final coat of an oily preservative. Some can be quickly freed of fouling formations by exposing them to a pneumatic blast carrying steel grit which produces a finely abraded surface that will take a lacquered or kindred finish. The same method is used to clean the large springs of the 3-inch gun mounts that absorb the "kick" of those rapid-fire weapons and return them to position for reloading.

Among the mechanical refinements of the apparatus salvaged are ball bearings ranging in diameter from sizable to small assemblies not exceeding the dimensions of a dime. The races and balls are washed in kerosene to rid them of grime or hardened oil and are then blown clean and bright with forceful jets of compressed air. In fact, compressed air performs many services in the ordnance division. It is provided by two 2-stage Ingersoll-Rand Type XRE compressors each of which has a piston displacement of 1545 cfm. and is driven by a 250-hp. motor. The units are equipped with a Type M aftercooler, and each machine has a silencer-air filter. Two standard I-R air receivers are available, and these supply the lines leading into the shops and to the various points of operation.

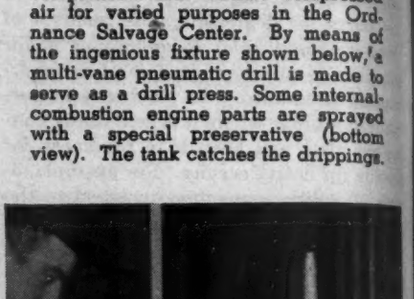
Now we come to the Internal Combustion Engine Salvage Section. There a working force, varying from 300 to 650 as activities may require, has helped to put and maintain in operating condition engines serving either as primary or auxiliary motive units aboard vessels ranging from PT boats to the biggest of our battle wagons. During the war, when naval operations were at their climax, the plants of the country were taxed to the utmost to supply the internal-combustion engines for that force, as well as the inevitable replacements and spare parts.

PARTS AND MORE PARTS

The entire bay illustrated at the right is given over to sorting parts of internal-combustion engines preparatory to examining them with a view to salvaging those that are worth it. The other picture shows women workers reclaiming for reuse parts from obsolete fire-control equipment of naval guns.

COMPRESSOR AND USES OF AIR

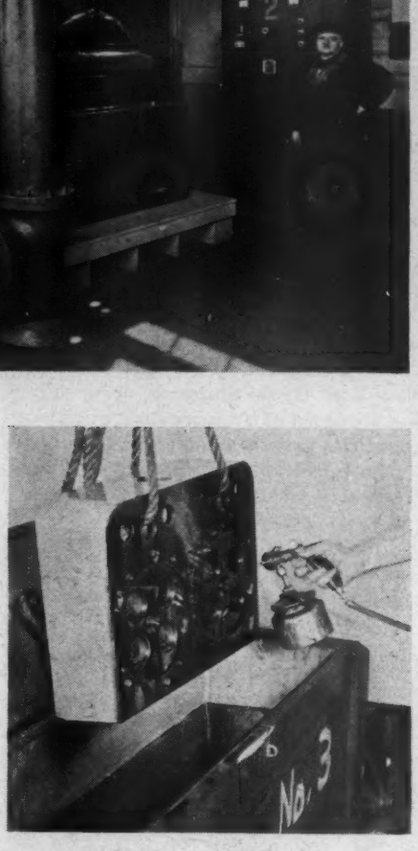
At the left is one of the two Type XRE compressors that furnish compressed air for varied purposes in the Ordnance Salvage Center. By means of the ingenious fixture shown below, a multi-vane pneumatic drill is made to serve as a drill press. Some internal-combustion engine parts are sprayed with a special preservative (bottom view). The tank catches the drippings.



Worn and damaged engines and engine parts from all sorts of craft sooner or later were shipped to the New York yard and, subsequently, to Maspeth Annex for handling and disposal. The work proved much more complex than might be imagined offhand, and in the case of certain obsolete parts even involved engineering changes to adapt them to current needs.

The Navy uses several hundred makes and sizes of internal-combustion engines, the structural features of which differ considerably. Returned parts may be spares that have lain in storage and become corroded; they may be damaged, but not beyond repair; or they may have concealed fractures that must be discovered so as to determine whether they should be reconditioned. But first they have to be identified, and this is apt to be difficult because the shipments often arrive in nondescript containers bearing no marks to indicate the type of engine from which the parts came.

The cavernous storerooms are piled high with boxes and crates, just as are those in the Ordnance Salvage Center. Unpacking is done in one of several big bays, and a group of trained workers has the seemingly bewildering responsibility of identifying each part and assigning its place in the set-up of an internal-combustion engine of given design and size. These workers must possess more than commonly good memories. To help them, large photostatic prints of many kinds of engine parts are arranged like a decorative frieze along the upper section of the side walls of each bay. But even that display includes but few of the drawings that have to be kept in mind or available for reference. At one side of the bays is a room equipped for the filing of microfilms, and there a force of microfilm readers



projects the tiny pictures upon the focusing screens. Thousands of greatly enlarged images of internal-combustion engines and of their manifold parts can thus be made visible and are of great aid to the examiners in assorting and grouping shipments to facilitate inspection. Should the latter favor reconditioning, then work starts.

The first step is to clean away the dirt and to remove oxidation. Grime and grease can be got rid of by vapor degreasers or solvent baths—the choice depending upon the nature of the surface and the part itself. For example, take a cylinder liner shipped with a heavy coat of grease to protect it from the corrosive action of moisture. That grease can be removed by brief immersion in a vapor solvent. Next, the metal surfaces must be closely scrutinized to detect cracks or incipient fractures that are ordinarily invisible. These are revealed by a magnetic apparatus—the Magnaflux—based on the well-known action of a magnetized-iron or steel part to attract minute iron particles to any cleavage or sharp edge, the particles outlining it and becoming still more visible when exposed to the "black light" of an ultraviolet lamp.

At Maspeth, a ferromagnetic powder is dusted on the surface; the engine part is magnetized by passing through it an electric current of high amperage but low voltage; and the minute particles pile up in a tell-tale manner along the structural defect, no matter how fine. The powder is available in various colors that make the position and the scope of the hairline break more easily discernible. The surface to be examined must be clean and dry. The location and extent of a crack determines whether or not it is economically worth while to repair the part. If that is done, then the worn surfaces are built up by metal-spraying, chrome-plating, or iron-plating—the choice depending upon the nature of the part and the accessibility of the surface to be processed.

One means of getting rid of oxidation and grease from iron or steel parts is the Kolene process. It has proved to be especially effective in removing rust, hard carbon deposits, and the "varnishes" acquired by cylinder liners during operation, as well as in preparing cast-iron surfaces for resizing by iron-plating. The bath, which consists of a combination of molten catalytic salts, is raised to a temperature of 800°F. and activated electrically. The part to be treated is suspended in the solution and connected to a direct current of 6 volts but an amperage lower than that used in electroplating. Further, it is possible to reverse the current as the treatment proceeds. In the beginning, the metal part acts as the anode or the positive pole of the system, and this promotes

the formation of oxidizing chemicals adjacent to the part, inducing bubbling. After a few minutes, the current is reversed and a reducing action takes place at the work. As a result, impurities on the part and any readily oxidizable matter are changed to oxides during the initial or oxidizing cycle; next, when the current is reversed, the oxides are reduced and cause the formation of minutely divided base metal that is swept away from the part by the agitated bath. In this way, iron and steel can be cleaned to a point where rinsing with water produces surfaces that are ready, when dry, to be coated either by metal-spraying or iron-plating. The Kolene process is also used at the annex to remove chromium-plating, which is occasionally found to be defective after it has been applied.

In the case of large crankshafts, metal-spraying has proved to be a satisfactory method of building up a worn surface to provide ample mass for machining and finishing to exact dimensions. Wire of the required metallic composition is fed at a mechanically controlled speed to each gun, where it passes through a fusing flame of oxyhydrogen or oxyacetylene and thence through an electric arc—the actual spraying of the molten metal being effected by compressed air to spread it over the receiving surface. Should it be that of a crankshaft, the latter is rotated at a uniform speed while being coated.

When a part can best be renovated by chromium-plating, which is usually much more resistant to wear than the parent metal, then the damaged area is immersed in a bath of chromic acid. In resizing cylinder liners, the procedure ordinarily followed is modified in that they are placed in a second bath of chromic acid and the activating current is reversed to impart to the deposited film an etched or roughened surface that becomes apparent only under a microscope or a magnifying glass of high power. After that, the depth between the ridges is reduced by a honing machine, which is halted occasionally to examine the work so as to discontinue honing when the surface still retains sufficient depressions or hollows to hold the oil that is to lessen friction between the moving parts—a virtue of chromium-plating. Following rehabilitation, cylinder liners are mounted on blocks and subjected to hydrostatic testing.

Small Utility type air hoists handle parts between cleaning baths and points where machining or other operations are performed, and compressed air is the driving energy for high-speed grinding tools and other pneumatic equipment in the Internal Combustion Engine Salvage Section. The air used there is supplied by two compressors, a small unit and a 2-stage, air-cooled machine—Ingersoll-Rand Type 40—with a piston displacement of 445 cfm. It is operated by a 75-hp. motor and furnishes air at a pressure of 100 pounds.

In the course of the fiscal year ending June 30, 1945, as many as 65,000 standard engine parts were reclaimed and sent to the Naval Supply Depot at Mechanicsburg, Pa. The total value of the material salvaged during the fiscal years 1944 and 1945 was $9,430,000, of which $9,167,000 was the showing for the fiscal year 1945 alone. The work done during that record year had a value of $1,898,000, with a steady rise from $344,000 in the first quarter to a maximum of $559,000 in the last quarter. New parts worth $3,588,000 were processed in 1945—none in 1944. The value of other kinds of matériel reclaimed was $300,000 in 1944 and $3,681,000 in 1945. Expenditures were $196,000 in 1944 and $1,772,000 in 1945, or $1,968,000 for the two years. In 1944 to 1945, the total reclamation cost was 19 percent, and this factor remained the same for the fiscal year 1945. These figures reveal how worth while and helpful has been the work done by this section of the annex.

At the highest stage of arrival at Maspeth, as many as 1700 tons of engine parts were delivered monthly, and by July, 1945, a million and a half pounds had been made ready for reuse. At first, only material from certain outside sources was received for salvage, but after the collapse of Germany the Bureau of Ships decided to make the plant a clearing house for internal-combustion-engine parts from the world over. The peak of the backwash from Europe has passed, and there is no knowing what will be returned from the various bases that were established in the Pacific. Much of the future work will have to do with equipment and engine parts that have been exposed for months in storage to the corrosive action of humid climates. These will be reprocessed to preserve them from impairment while held for long periods in places where heat and moisture prevail.

In preparing parts for storage of this kind, the Navy makes extensive use of a plastic dip that excludes all air from the metal surfaces. The protective film is firm and strong and, while it clings snugly, can be stripped off easily. Each part is covered with a thin oil-like coating after cleaning to protect it from corrosion while in the plant awaiting final coating and packing. The plastic dip is melted in electrically heated tanks; and on each part, before immersion, is pasted an identifying label that can be read through the envelope after it has solidified—which it does quickly. This prevents the loss of tags or labels in handling overseas shipments and avoids the trouble now experienced in identifying the contents of packages. Relatively small articles that are not given this treatment are securely wrapped in tough, moisture-resistant paper; and, as an added safeguard against humidity, the entire package is given a dip in melted wax.

The war has taught us many useful things that have potentially wide application in normal times, and packing procedures are among them because our future overseas trade will inevitably reach farther afield and be greater in volume than heretofore.

MICROFILM READERS

In this room, magnified images of countless parts of internal-combustion engines of many different types and sizes are projected on screens to help trained workers identify and sort them for inspection to determine whether they should be scrapped or reconditioned.

Pressurized Airplane Cabins for Stratosphere Flights

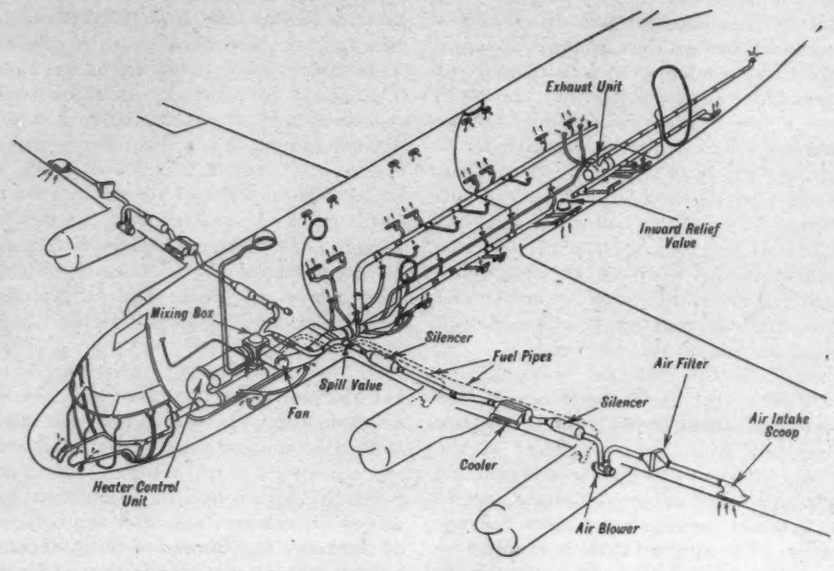


DIAGRAM OF CABIN-PRESSURIZATION EQUIPMENT

IT SEEMS certain that future, long commercial airplane hops will be made in the stratosphere, where flying conditions are most favorable. This will be especially true of transatlantic winter flights because the chances of ice formation are greatly reduced in the dry air that prevails above 20,000 feet. In preparation for this service, extensive research has been conducted in the field of cabin pressurization to mitigate the effects of altitude on passengers and crew. A report on the progress that has been made along this line by one British aircraft manufacturer was recently presented in *The Engineer*, of London, from which these facts have been extracted.

The Avro *Tudor I*, constructed by A.V. Roe & Company, Ltd., in Manchester, was designed from the outset for pressurization of all the fuselage except a small part of the tail. The plane is now being turned out on a production basis, and the first units will shortly go into commercial service. It is built and equipped to maintain atmospheric conditions of 8000 feet in the cabin when flying at a height of 25,000 feet. Test flights at altitudes greater than Mount Everest have been made, and passengers reported that they felt no discomforts. To impress upon them that bodily functions are normal under those conditions, alcoholic beverages were served by representatives of the company at a height of 25,000 feet and they had no more effect than if they had been imbibed on the ground.

The accompanying sketch shows the arrangement of the pressurization equipment, which includes apparatus for heating and ventilation. Units for humidification and refrigeration are not yet in the production stage, but they are being developed. It is the opinion that moisture will have to be added to the air during long flights at high altitudes and that the air will have to be cooled while planes are on the ground or starting off in warm climates.

Outside air is drawn in through a combined scoop and inertia filter in each wing leading edge, the intakes being located beyond the airscrew flow and away from the area that is contaminated by exhaust gases. The air passes through ducts leading to the blowers, of which there are two, one mounted on each outboard-engine accessory gearbox. On its way from a blower to the fuselage, the pressurized air is conducted through two silencers and a cooler that is interposed in the line between them. It then enters the cabin through a spill valve that embodies a nonreturn valve to insure against loss of inside pressure should one of the blowers fail.

Within the fuselage the air is fed to a recirculation-fan chamber that is heated by a surface combustion unit burning airplane fuel. The heater can be adjusted to deliver either 50,000 Btu's per hour or approximately half that output. Any desired air temperature can be obtained by jointly regulating the coolers and the heater. However, on test flights at heights of 25,000 feet and with the outside temperature at minus 88°F., the heat imparted to the air by compression alone was sufficient to maintain a comfortable temperature within the cabin. The heater is served by a separate piping system to admit and exhaust the required combustion air.

The recirculating fan pushes the pressurized air through a main duct that runs beneath the floor the full length of the cabin and from which take-offs extend to the cabin space above. In the crew spaces and toilets these terminate in mushroom-headed outlets, but the air supply for the passengers flows through the hollow tubular arms of their chairs. The air is exhausted through slots arranged around the reflectors of the ceiling lights. Some of this vitiated air is then routed to the recirculating-fan chamber and mixed with the incoming fresh air from the blowers; the remainder is discharged near the rear of the cabin through a valve that incorporates a safety valve. At 25,000 feet altitude the differential in pressure between the interior and exterior of the cabin is kept at 5½ pounds per square inch. The amount of air passing out is regulated in the flight-engineer's compartment by two aneroids that are connected with the discharge valve.

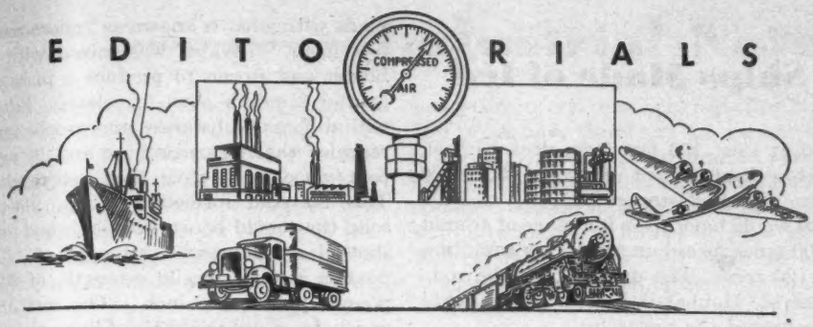
The cabin is rendered airtight during assembly by sealing all metal-to-metal joints with a compound that is either brushed or sprayed on. All control rods and cables that go through the fuselage are fitted with pressure seals at their points of emergence. The entrance door, cabin windows, and astrodome are made tight with inflatable rubber-tubing inserts, and the nose cap with a solid rubber insert. Extensive preliminary investigations were carried on to develop a fuselage structure that would be sufficiently airtight under all conditions and that would also withstand the pressure differential. To make sure of this, the cabin was designed to stand up under a differential of 11 pounds per square inch, or twice that at an altitude of 25,000 feet.

Record Water Wheel Drives Compressor

WHAT is claimed to be the largest Pelton type of water wheel in existence operates a compressor that furnishes air to the Morning Mine in the Coeur d'Alene District of Idaho. The wheel is 104 feet in circumference. The water that drives it falls 1200 feet and is directed through six nozzles at a pressure of 520 pounds per square inch. The buckets on the wheel travel at the rate of 94½ miles an hour.

The large wheel is aided by two 12-foot ones operated by water that has a drop of 110 feet, and the compressor delivers 5200 cubic feet of air per minute. The air is piped 6 miles to the mine where it is used. The plant was built in 1900 by Larson & Greenough, who then owned the Morning Mine, and has been in continuous service ever since. In periods of low-water flow when its output falls below requirements the difference is made up by two electric-driven compressors housed in the same building.

EDITORIALS



POWER-TRANSMISSION TESTS

TWO experimental electric transmission lines that will materially influence the trend of power transmission are being erected at a fuel-burning generating station in Ohio. They are only 1½ miles long, but they will suffice to answer a lot of questions that are now in the minds of electrical engineers. Current will be carried over them at voltages up to 500,000 to permit making studies of all the functional and financial aspects involved. The aim is to ascertain whether it will be feasible and economical to adopt higher voltage systems to distribute the larger blocks of electrical energy that will be needed to meet the growing demands.

Higher voltages enable lines to transmit power longer distances than low voltages, but the cost of the larger-capacity equipment required is greater. The projected experiments will seek to determine optimum voltages and lengths of line. The information will be useful regardless of whether the energy comes from conventional stations or from the atomic-power plants that the future may bring forth. The lowest-cost power now obtainable is that from fuel-burning generating stations situated close to the areas of consumption, and it is to be used as the standard of value for comparison. Such a plant, when operating at half its rated capacity, can produce electricity at around 0.5 or 0.6 cents per kilowatt-hour. At the voltages now employed, that energy can be carried for around 0.1 cent per 100 miles. In other words, it costs about as much to transmit it 500 miles as it does to generate it.

Fortunately, fuel-burning stations can be located near load centers, so the economics of transmission is less important in their case than in that of hydroelectric plants that have to be built where waterpower is available. Hydro stations can be operated at lower cost than fuel-burning plants, but their first cost is higher. And if the power has to be carried long distances, the over-all cost to the consumer may be greater than it would be if a fuel-burning station were set up nearby, even allowing for the possible expense of having to ship in fuel. Higher voltages may equalize some of these differences, and may also permit the interconnection of power plants throughout a greater area.

The highest-voltage transmission line now in commercial operation is the 287,000-volt system extending from Boulder Dam to the Pacific Coast. Until it was placed in service the record was 220,000 volts. Engineers are now talking about voltages up to 400,000, and the tests soon to be conducted in Ohio will largely determine whether or not they are to be adopted. The experimental lines are being set up through the joint efforts of The American Gas & Electric Corporation and nine manufacturers of transmission equipment.

BETTER BUILDING CODES

ANY fair-minded person will agree with the idea that laws and regulations should be revised from time to time if they are to keep pace with continually changing conditions in the fields to which they pertain. A simple example is the necessity, which has arisen in our generation, of amending the traffic laws to make them applicable to the automobile age. Oftentimes, however, the changes in regulations lag behind progress. This is true of our building codes. Some of the provisions that are now in force in different localities were written during the horse-and-buggy era of construction and need to be brought up to date.

This situation has long been recognized by interested individuals and groups, and considerable headway has been made in correcting it. Nevertheless, many codes are still inadequate in the light of modern conditions and are definitely impeding construction and adding to its expense at a time when we can ill afford to have such brakes applied. In an effort to clear away the obstructions, the Construction Division of the Department of Commerce and the Bureau of Standards are taking the lead in a movement to bring about modernization and standardization of building codes throughout the nation.

This is being done by studying the codes of representative municipalities and comparing their provisions with a comprehensive list of generally acceptable standards. Special attention is being given to ferreting out requirements that restrict building or add to its cost. Where these are found to exist, they will be pointed out for the guidance of the regulatory bodies that have the power to change them.

Building codes were originally designed to insure structures that would adequately protect life and health and contain reasonable safeguards against fire and collapse. During the reign of King Hammurabi of Babylon from 2067 to 2025 B.C., an edict was issued that put the responsibility on the builder, who was both architect and artisan. Its provisions were drastic, but undoubtedly effective. If a house collapsed and caused the death of the owner, the builder was put to death. If a son of the owner was killed, then a son of the builder had to die. If a slave of the owner lost his life, the builder had to replace him with one of his own slaves. Furthermore, if it was proved that a house collapsed because it had not been firmly constructed, it had to be rebuilt at the builder's expense.

During the intervening 40 centuries, emphasis has properly been placed on soundness and safety. Until a few decades ago, building materials and construction practices remained pretty much as they had been for ages, and there was little need for code revision. In recent times, however, the development of new materials and techniques have made some provisions obsolete. While some municipalities have taken account of these changes, others have not. As a consequence, building codes vary widely. These differences are so pronounced as to cause one engineer who examined several codes to remark: "I never knew before that 2 plus 2 equals 5 in one city, 8 in another, and only 1½ in another; that people weigh more in Detroit than they do in New York; that it takes more inches to get people out of theaters in Chicago than in other cities; and that fires burn more vehemently in Kansas City than they do in St. Louis."

There are two general classes of building codes—the specification and the performance. The specification type may say, for instance, that a brick wall shall be at least 12 inches thick; and, as a fire-protective measure, it may call for permissible materials of certain minimum thicknesses. The performance or functional code, on the other hand, may direct that all parts of structures be designed to support safely their own weight plus all other loads imposed upon them. As regards fire protection, it will no doubt require a type of construction that will withstand a fire test of so many hours.

The specification type now predominates, although the current trend is towards its abandonment. Those who have given most study to the subject believe that a combination of the two is to be preferred. However, the main objective is not to determine the best form of code but, rather, to write one that will contain adequate safeguards without putting obstacles in the way of the builder and unnecessarily adding to the owner's cost burden. Untold thousands will give their blessing to this worthy effort.

Ships Made of Ice

IT IS now revealed that at one stage in the war the Allied governments were actively pursuing the novel idea of constructing floating airplane bases of ice. As they were to be equipped with diesel-engine plants that would propel them at a speed of around 7 knots they could be classed as aircraft carriers. The idea was suggested by Geoffrey Pike, director of Programmes at the Combined Operations Headquarters in London. As a former war correspondent, he had studied Arctic warfare. Beginning in 1942, extensive investigations of the proposed ice ships were conducted, and they actually might have been built and used as an aid to the invasion of Europe had not events taken a turn whereby Great Britain could serve as a base.

As described in *The Engineer* of London, each "iceberg aircraft carrier" was to have been 2000 feet long, 300 feet wide, and at least 150 feet from deck to keel, with a displacement of around 2,000,000 tons. Fuel-oil storage capacity of 5000 tons would have given it a range of around 7000 miles, based on a daily consumption of 120 tons. The project bore the code name of "Habbakuk." Winston Churchill encouraged the research.

In approaching the problem, it was realized that ice lacked the necessary inherent structural characteristics, and the studies consequently took the line of seeking some means of reinforcing, much as concrete is strengthened to meet certain requirements. After beams of ice up to 40 feet long and with various reinforcing had been proved unsatisfactory, tests were made with what is known as "micro-reinforcement." Water was mixed with a binder and frozen to produce a mass of greater strength than ice alone. Trials with different substances and proportions revealed that 86 percent ice and 14 percent wood pulp gave the best results. This material formed a tough, plastic solid that could be worked like wood and showed a compressive strength of 1100 pounds and a tensile strength of 700 pounds per square inch. The mixture, which was given the name of Pykrete, was difficult to make even under Arctic conditions. The wood and water had to be mixed into a pulp, rolled on a flat surface to a uniform thickness of ⅜ inch, and then frozen with a cold air blast.

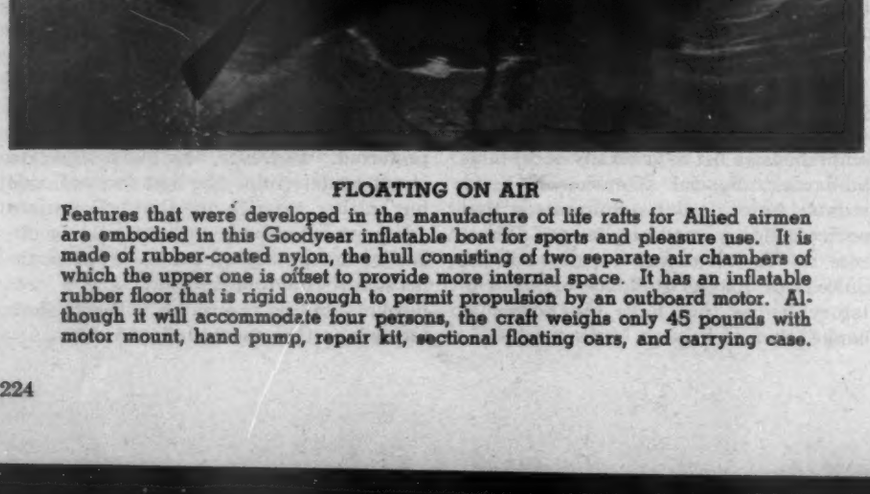
The design called for combining sheets of this material into a laminated structure of blocks 40 feet thick, and it was computed that 1,700,000 tons would be required for one floating base. Tests of the Pykrete showed that it was highly resistant to shock such as is produced by modern weapons, its bomb-resisting quality being 40 percent of that of the best reinforced concrete. It was also found that the rate of melting was materially slowed down because an insulating layer of wood pulp adhered to the surface long after the ice encasing it had melted, thus delaying seepage of the surrounding warm water to the ice in the interior. Nevertheless, an exterior insulating skin was contemplated, with pipes behind it for the circulation of brine from a large-capacity refrigerating plant. With these precautions, it was believed that an ice carrier could operate for a long time in temperate zones and even in the Gulf Stream.

To determine what effect heavy weather might have on such a structure, investigations were conducted in the Froude Tank of the National Physical Laboratory and it was decided that the only safe course would be to make it resistant to waves 1000 feet long and 50 feet high. It was revealed that these specifications could be met only by building the floating base in the form of a hollow girder, with keel and sides 50 feet thick and with transverse bulkheads or subdivisions. It was planned to utilize some of the space below deck for hangars, machinery, workshops, stores, and living accommodations for the crew. A vessel large enough to serve 200 Spitfire fighters or 100 Mosquito bombers was expected to have a complement of 374 officers and more than 3200 petty officers and men.

One of the problems in connection with the project was suitable construction sites, the requirements being intense cold, a clear depth of 150 feet of water close inshore, and proximity to a pulp mill. In the end, Canada offered the only suitable places, namely, Corner Brook, Newfoundland, and Seven Islands Bay, Quebec. Much of the experimental work was carried on at Lake Louise in the Canadian Rockies.

Air-Space Windows for Many Services

WINDOWS having two panes of glass with an air space between were introduced ten years ago for use in air-conditioned railroad cars. Under the name Twindow, the Pittsburgh Plate Glass Company is now offering similar ones for industrial, home, business, commercial, and special applications. They consist of two or more plates of glass ¼ or ½ inch apart between which air is hermetically sealed. They are suitable for stores because the insulating property of the air does not permit the transfer of cold temperatures from the outside and thus prevents the formation of frost on the inner glass surface. This feature also makes it possible to install larger than normal windows in offices and homes and at the same time reduces heating and air-conditioning costs. Clear polished plate glass is used in the case of standard units, and special glasses where they serve a purpose. In airport towers, for instance, where the direct rays of the sun constitute a problem, heat-absorbing glass is specified. Water-white plate glass which permits of true color definition with maximum clarity of vision is available for the multiple glazing of test chambers designed for low temperatures and high and low pressures.

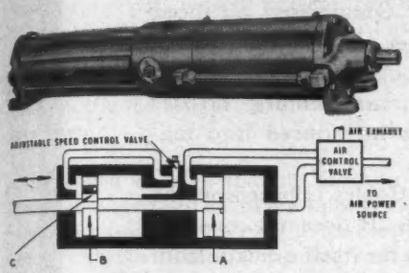


FLOATING ON AIR

Features that were developed in the manufacture of life rafts for Allied airmen are embodied in this Goodyear inflatable boat for sports and pleasure use. It is made of rubber-coated nylon, the hull consisting of two separate air chambers of which the upper one is offset to provide more internal space. It has an inflatable rubber floor that is rigid enough to permit propulsion by an outboard motor. Although it will accommodate four persons, the craft weighs only 45 pounds with motor mount, hand pump, repair kit, sectional floating oars, and carrying case.

Industrial Notes

Fast-acting air operation and accurate hydraulic control are combined, it is claimed, in the new double-acting Air-Draulic cylinder recently announced by the Logansport Machine Company. As the accompanying sketch shows, it features two separate cylinders assembled as a unit on a common piston rod. As the latter is moved by admitting compressed air to the pneumatic cylinder through the medium of a 4-way valve, oil is caused to flow between the chambers of the hydraulic cylinder. Built in the circuit which connects these chambers is an adjustable speed-control valve which regulates the flow of oil and, therefore, the movement of the piston rod. No hydraulic power unit is required. Cylinders come in four standard sizes from 3- to 8-inch bore and with any length of stroke up to 5 feet. Five standard types of mountings are available—foot, clevis, center-line, blind-end flange, and rod-end flange.

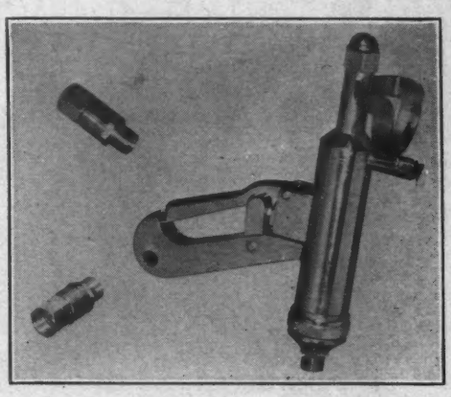


AIR POWER—OIL CONTROL

At the right in the conventionalized diagram of the Air-Draulic cylinder is the air-operating circuit; at the left the hydraulic regulating circuit. *A*, air piston designed to function at a maximum pressure of 150 pounds per square inch; *B*, hydraulic piston; *C*, ball check valve which permits free return in either direction. Cylinder is also built for controlled feed in both directions and for skip-feed movement. The unit shown at the top is of the foot-operated type.

Once in a while something new appears on the market and one wonders why it has not been thought of before because it is such an obviously simple and useful thing. Of that order would seem to be the folding steps for trucking vehicles recently announced by the Safety Step Company. There are different models designed for flat racks, stake bodies, vans, trailers, as well as semitrailers, and for side, back, and tight-spot mounting. Sturdily built of metal with two slipproof steps, each unit is fastened beneath the truck bed and will support a weight of 1000 pounds. Operation of a trip causes it to swing down and lock, while a slight lift and push on the bottom step folds it back out of the way and locks it. Installation requires no body alterations. Goes by the name of Saf-T-Steps.

Accessory welding equipment for underwater work developed primarily for the U. S. Navy by the JO Manufacturing Company is now available for industrial use. It consists of a torch lighter and of flashback arresters that are said to have been of material assistance in the salvage and repair of government ships. The former permits a diver to light and relight his welding torch while submerged at varying depths, and the latter, which are interposed between the torch and the fuel and oxygen lines, automatically cut off the supply when the torch is disconnected and protect the hose and regulator against flashback and bursting. The lighter works pneumatically—without electrical connections, and is designed for pressures ranging from 30 to 120 pounds.

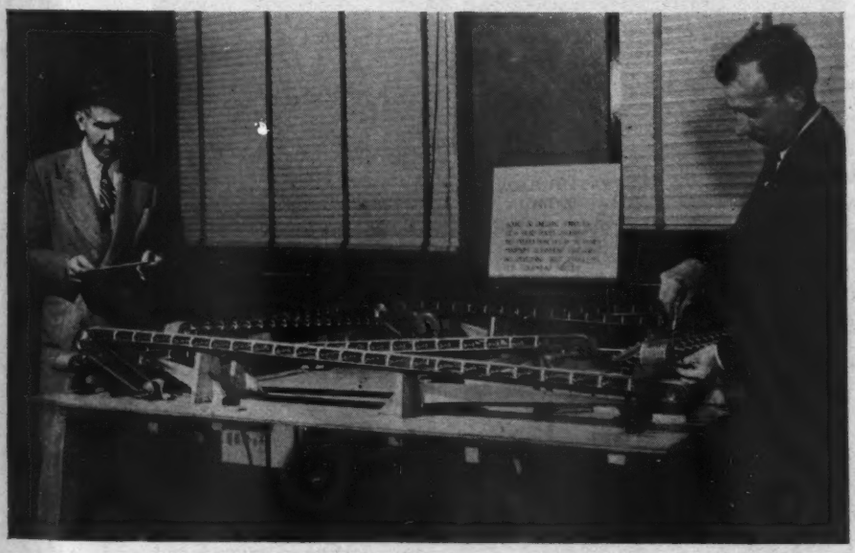


SUBMARINE-WELDING AIDS

Picture shows the Diamond S flashback arresters (left) and the underwater-torch lighter. The U-shaped bar at the top-right of the latter is mounted on the nozzle and helps the diver to position the welding torch at depths where visibility is poor.

It is attached to an air line and provided with a heavy pistol grip and a horseshoe-shaped bar to guide the torch into lighting position. When properly placed, the diver squeezes the grip, thus releasing air at sufficient pressure to form a protective envelope around the torch just as a strong spark shoots out and ignites it.

Like the fabled phoenix, cities laid waste by bombs and fire during the recent war are to rise out of their own ashes. A German physicist and engineer is reported to have developed equipment for making high-strength, interlocking blocks from rubble, thus solving at one stroke the serious problems of disposal and housing in places such as Hamburg, Cologne, and Berlin. In our own country we have been manufacturing building material for some time by standardized portable machines, and these are already playing a vital part in the reconstruction of devastated areas in Europe. The various units can be strung together much like a train and moved individually from one site to another. Conversion from the raw to the finished product is a continuous one, the rubble—brick, mortar, stone, and concrete—entering a crusher at one end and emerging from a molding machine at the other. The intermediate steps consist of

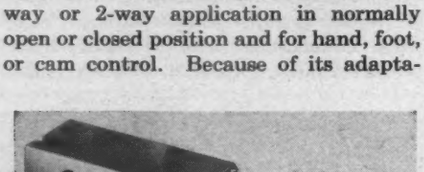


TWO-WAY CONVEYOR BELT

Four miniature conveyors with their belts arranged so that each can carry a load in two directions. Conveyors of this type will have their chief application in steel plants where ore can be hauled in and slag taken out on the "return run." These models were made by The Goodyear Tire & Rubber Company for exhibition at a recent conference of its Mechanical Goods Division in Akron, Ohio. C. F. Smith, the designer, is shown at the left. P. D. Suloff, another Goodyear employee, is adjusting the conveyor system at a transfer point.

classifying the aggregate by passing it through screens of different mesh; loading measured proportions of each grade, cement, and water into a concrete mixer; and feeding the batch to vibrating molding machines where it is compressed into blocks, roofing tile, or other building materials that are ready for use after curing.

The Modernair CRV pneumatic pilot valve recently announced by Modern Products, Ltd., is designed for either 3-way or 2-way application in normally open or closed position and for hand, foot, or cam control. Because of its adapta-



PNEUMATIC PILOT VALVE
Unit is designed for 3- or 2-way operation and is shown assembled (top) and disassembled.

bility, it is suitable for the operation of air controls, valves, and single-acting pneumatic cylinders such as are used to actuate vises, collet closures, and holding jigs. It is also adapted for service where time-sequence control over air motors is required and where the first unit in the sequence is operated manually or automatically. Aircraft-type packing as bearing points on the piston rod eliminates metal-to-metal contact and permits "renewal" of the valve by the replacement of four packing rings. Plunger is secured by an end plate that can be removed without breaking air connections and cannot come out of the housing during valve installation or operation. The Modernair CRV is said to be fully balanced and to operate freely and easily under conditions of extreme pressure variation.

Phenolex is the trade name of a new aluminum paint suitable for metal, wood, masonry, wallboard, tile, etc. Applied either by brush or air spray, it is said to provide a flexible coating that is nontoxic and will not contaminate foodstuffs. It is shipped in double-compartment containers, one carrying the aluminum in powder form and the other the mixing vehicle.

To protect steel and galvanized products against corrosion in the interval between cleaning and painting, Hagan Corporation is offering a powder called Banox which, when dissolved in water,

forms a flexible phosphate coating. A 1 to 2 percent solution as thin as 0.000005 inch is said to be effective, and serves at the same time as a base for the paint or lacquer, thus supplementing the anti-corrosive action of the finish.

Small permanent magnets varying in design from rings and disks to intricate shapes are being produced by the General Electric Company from five different war-born materials named cunico, cunife, vectolite, alnico 12, and silmanal. They are made of wire, strip, or rod stock and have many industrial applications, especially in the manufacture of airplane instruments.

Designed to span the gap between a plant conveyor and a truck or railway car, the new telescoping belt unit of the Standard Conveyor Company permits loading and unloading without rehandling freight. The portable section is 28 feet 4 inches long, has an over-all width of 19 inches, and can be extended 18 feet. The stationary conveyor is attached to this wheeled frame, thus providing a continuous receiving or discharging system. The belt itself is 14 inches wide. On its return run it moves over rollers in the retractable section, but when loaded it rides a second set of rollers except for a short distance when it travels over the driving pulley in the frame, which also supports the motor. The top of the pulley brings the belt in line with the plant conveyor. Carrying capacity of the portable unit is 20 pounds per foot.

Wartime experiments carried on by the General Electric Company under contract with the Office of Scientific Research and Development for the purpose of providing a suitable solder for the construction of vacuum tubes have resulted in an alloy composed of 37½ percent gold and 62½ percent copper. The material has been used effectually in making as many as twenty different types of joints that have been found to be proof against leakage and mechanical failure in service. Among other metals, copper has been soldered to steel, copper to fernico, and copper to copper. Diffusion seals between pure copper parts have been made with 0.03 inch gaskets of the new alloy and are said to be stronger mechanically than similar ones of pure gold. The melting point of the gold-copper solder ranges from 950 to 990°C. (1742-1814°F.), and this is of advantage when fernico is soldered to copper and then sealed to glass because the joint may become quite hot during the sealing process. Detailed information about the alloy and its applications are contained in a report (PB-15151) which is obtainable in photostat form, $1, or microfilm, 50 cents, from the Office of the Publication Board, Department of Commerce, Washington 25, D. C.

Industrial Literature

A new booklet issued by Hercules Powder Company, Wilmington, Del., lists its chemicals and industrial explosives and indexes them according to the more than 50 industries that use them. The products are arranged in groups, and the salient features of each are given. The booklet is called *Hercules Products*.

A 28-page, pocket-size booklet describing the complete line of industrial rubber products made by The B. F. Goodrich Company, Akron, Ohio, is obtainable upon request. All types of hose and hose couplings, conveyor and transmission belting, adhesives, lining materials for various purposes, and industrial clothing are among the items listed.

A new catalogue describing air-control valves is offered by Valvair Corporation, 454 Morgan Avenue, Akron 11, Ohio. These valves are of the 2-, 3-, or 4-way type, and are designed to function by any one of numerous methods. Standard valves operate on air pressures up to 200 pounds and temperatures up to 120°F.

Bulletin 144 of the Shenango-Penn Mold Company, of Dover, Ohio, describes the firm's line of castings of plain and alloyed irons, with emphasis on those produced by the centrifugal method. Among the advantages claimed for centrifugal as against static castings are greater density without sand inclusions or blowholes, an increase of 2 to 3 points in Brinell hardness, 8 to 20 percent greater tensile strength, and less allowance of surplus metal for finishing.

Standard metal-cleaning and drying apparatus made by the Optimus Equipment Company, 153 Church Street, Matawan, N. J., is described in the company's bulletin 6E1. Seven basic types of machines are used for numerous washing, rinsing, and drying operations in connection with the handling of small parts. Some of the units are portable, and all are adaptable for the delivery of work to them by belts, racks, or baskets.

The Universal Drafting Machine Company, Cleveland 14, Ohio, announces a redesigned drafting machine under the name of Universal Boardmaster. It is said to be suitable for use on all types of drawing tables and to embody numerous improvements and refinements that were developed during the war. An 8-page descriptive bulletin is available.

Tests show that silicone varnishes used for the insulation of electrical machines provide greater heat and moisture resistance than the varnishes previously available for the purpose. Until recently, however, these superior properties were not always obtainable because of the high temperatures required to bake the varnishes. This difficulty has been overcome, it is reported, by a new silicone varnish produced by the Dow Corning Corporation, Midland, Mich., and designated as DC 996. Information concerning it is contained in a pamphlet titled *How to Use DC 996*.

Air cylinders are used in countless industrial services where a controlled push or pull operation is needed. They act either directly or through a lever or toggle. Hanna Engineering Works, 1765 Elston Avenue, Chicago 22, Ill., manufactures standard cylinders in diameters of from 1½ to 20 inches and with strokes as specified. They are designed to operate with air up to 110 pounds pressure and can be modified to use pressures up to 250 pounds. The complete line of Hanna cylinders is described in Catalogue No. 234.